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Publications of the

Anthropological Society of London. K

LECTURES ON MAN.

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LECTURES ON MAN:

HIS

PLACE IN CREATION, AND IN THE HISTORY OF THE EARTH.

BY

DR. CARL VOGT,

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TO

Dr. PAUL BROCA,

SECRÉTAIRE GÉNÉRAL DE LA SOCIÉTÉ D'ANTHROPOLOGIE DE PARIS, HONORARY FELLOW OF THE ANTHROPOLOGICAL SOCIETY OF LONDON, PROFESSEUR AGRÉGÉ A LA FACULTÉ DE MÉDECINE DE PARIS, CHIRURGIEN A L'HÔPITAL SALPÊTRIÈRE, VICE PRÉSIDENT DE LA SOCIÉTÉ DE CHIRURGIE DE PARIS, AND HONORARY FELLOW OF THE ETHNOLOGICAL SOCIETY OF LONDON.

My dear Dr. Broca,

Your kind permission to dedicate the following translation to you, affords me the opportunity which I have long desired of expressing my sense of the honour which your personal friendship confers upon me ; and at the same time enables me to testify my appreciation of, and admiration for, the incalculable services which your zeal and ability have rendered to the noblest of all sciences, the science of Man—Anthropology.

To those unacquainted with your labours* for this young science in France, and their triumphant results,

* The following list of Professor Broca's scientific works, especially bearing on the science of Man, will give some little idea of his industry, although they constitute but a small part of what that accomplished Anthropologist has published during the last few years :—

Recherches sur l'Ethnologie de la France, dans "Mém. de la Soc. d'Anthrop.," t. 1, p. 1, à 56, Paris, 1860, gr. in 8vo. Tiré à part, brochure de 56 pages avec une carte. *Mémoire sur l'Hybridité et sur la Distinction des Espèces Animales*, "Journ. de Physiol.," 1858, t. i, p. 432-471, p. 684-729 ; 1859, t. ii, p. 218-250, et p. 345-390. *Résumé des faits relatifs aux Croisements des Chiens, de Loups, de Chacals, et de Renards*, "Journ. de Physiol.," 1859, t. ii, p. 390-396. *Sur les principaux Hybrides du genre Equus, sur l'Hérédité des Caractères chez les métis et sur la Fécondité des Mules*, "Journ. de Physiol.," 1859, t. ii, p. 250-258. *Mémoire sur les Phénomènes d'Hybridité dans le genre humain*, "Journ. de Physiol.," 1859, t. ii, p. 601-625, et 1860, t. iii, p. 392-439. *Sur l'Influence durable de certains Croisements de Races*, "Bull. de la Soc. d'Anthrop.," 1859, t, i, p. 19-26. *Sur les capsules surrénales d'un Nègre*, ibid., t. i, p. 30. *Sur les Races primitives, contemporaines de l'époque dite du Dilu-*

a recapitulation of them here would sound more like a panegyric, than the simple recital of what one man has accomplished. I am therefore glad that the majority of those who will peruse this volume are already acquainted with what you have done for the establishment of Anthropology in your own country, and will join with me in a public recognition of your valuable services to science generally, and also in paying homage to the noble example you have set to lovers of truth, and students of mankind throughout the world.

Some seven years since, when I first had the honour

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vium, ibid., t. i, p. 70-76, p. 87-92. *Instructions pour le Sénégal,* ibid., t. i, p. 121-137. Tiré à part, broch. in-8vo de 16 p. *Remarques sur les Langues Polynésiennes,* ibid., 1860, t. i, p. 250-255. *Documents relatifs aux Croisements des Races très différentes,* ibid, t. i, p. 255-264. *Sur le Défaut de perfectibilité de certaines Races,* ibid., t. i, p. 337-342, p. 368-376. *Sur le volume et la forme du Cerveau, suivant les individus et suivant les Races,* ibid.,1861, t. ii, p. 139-204, et 301-321. Tiré à part, brochure in-8vo de 75 pages. *Sur les Poids relatif du Cerveau des Français et des Allemands,* ibid., p. 441-446. *Rapport sur les fouilles Pratiquées dans l'ancien Cimétière des Célestins,* Publié par la Ville de Paris : Paris, 1850, in-4to, 19 pages. *Sur des Crânes provenant d'un Cimétière de la Cité, antérieur au* XIIIe *siècle,* "Bull. de la Soc. d'Anthrop.," 1861, t. ii, p. 501-513. *Sur la Capacité des Crânes Parisiens des diverses époques,* ibid., 1862, t. iii, p. 102-116. Ces deux mémoires ont été tirés à part, brochure in-8vo de 32 pages. *Mémoire sur le Crâniographe et sur quelques-unes de ses Applications,* dans "Mém. de la Soc. d'Anthrop.," t. i, p. 349-378. Tiré à part, brochure gr. in-8vo, de 30 pages, avec 1 pl. *Sur la Détermination des Points singuliers de la Voûte du Crâne qui limitent les angles auriculaires,* "Bull. de Soc. d'Anthrop.," 1862, t. iii, p. 17-24. *Sur les Proportions Relatives du Bras, de l'avant-bras et de la Clavicule chez les Nègres et les Européens,* ibid., t. iii, p. 162-172. Tiré à part, brochure in-8vo de 12 pages. *La Linguistique et l'Anthropologie,* "Bull. de la Soc. d'Anthrop.," 1862, t. iii, p. 264-319. Tiré à part, brochure in-8vo de 55 pages. *Sur les Projections de la Tête et sur un nouveau Procédé de Céphalométrie,* "Bull. de la Soc. d'Anthrop.," t. iii, Novembre 1862. Tiré à part, brochure in-8vo de 30 pages. *Sur les Caractères du Crâne des Basques,* "Bull. de la Soc. d'Anthrop.," t. iii, Decembre 1862. Tiré à part, brochure in-8vo de 15 pages. *Second Mémoire sur les Caractères du Crâne des Basques,* "Bull. de la Soc. d'Anthrop.," Février 1863, t. iv. *Instructions Générales pour les Recherches Anthropologiques* (Anatomie et Physiologie).—"Mém. de la Soc. d'Anthrop.," *Par.,* vol. ii, in the press.

of being introduced to you, by our late lamented colleague, Dr. Robert Knox, I held, as you may remember, the office of Honorary Secretary to the Ethnological Society of London. Most heartily did I welcome the birth of your society, on behalf of that of which I was then an officer, believing at that time, the *Société d'Anthropologie de Paris* to be merely an Ethnological Society under another name. In watching the development of your Society and tracing the vastness of its extent and objects, under the administration of yourself and your illustrious colleagues, I soon perceived that pure Ethnology merely formed a part of the grand science then inaugurated by you. With the most intense pleasure and admiration, I witnessed the gradual establishment and progress of your Society, endeavouring at the same time with all my power to incite the Ethnological Society to similar efforts. This attempt, however (truth compels me to record), proved a signal failure—a circumstance which caused me disappointment at the moment, but which I now consider fortunate; for I soon became aware that Anthropology and Ethnology could never become synonymous terms, inasmuch as the latter merely constitutes a part of the comprehensive science of Anthropology.

I am glad to state that, at the present time, this profound distinction is fully admitted by unbiassed persons in England. My failure, however, in arousing the Ethnological Society from its torpor, was not attributable to this confusion of terms, the matter not having then received public attention in this country, but arose entirely from the opposite views held by myself and my colleagues as to the objects of the Ethnological Society, and its duties as a scientific body.

The stand-point claimed for the science of Ethnology by the late Dr. Knox, by Captain R. F. Burton, the present senior Vice-President of the London Anthropological Society, by myself, and by some others, was that of a grave, erudite, and purely scientific study, requiring the most free and serious discussion, especially on anatomical and physiological topics, for the elucidation of the many difficult problems arising out of the subjects brought forward. This, however, was far from being the opinion of a large and powerful section of the Society, headed by my venerable friend, Mr. John Crawfurd. The party under his leadership desired to place the Ethnological Society on a footing with the Royal Geographical Society, and to render its meetings fashionable and popular by the admission of ladies. You will, doubtless, smile at the strange idea of admitting females to a discussion of all Ethnological subjects. However, the supporters of the "fair sex" won the day, and females have been regularly admitted to the meetings of the Ethnological Society during the past three years.

Even now the advocates of this measure do not admit their error, nor do they perceive how they are practically hindering the promotion of those scientific objects which they continue to claim for their society. On the contrary, they rejoice at their victory, and Mr. Crawfurd has publicly on more than one occasion ascribed the success which attended the Ethnological Society under his *régime* to the admission of ladies.

Apart from this fatal mistake, you will readily understand that other important, and indeed vital differences, existed as to the mode in which such a society should be conducted. Finding myself, therefore, unable to give my cordial support to a society whose apparent objects were so utterly

at variance with my own views—views in which I was not without supporters—the idea occurred to me of establishing in this country a really scientific society, which, taking yours as a model, might become worthy of a great nation.

Here, my dear sir, I will pause : what we have achieved is already known to you ; what we hope to do I trust you will live to see in a great degree accomplished. I cannot however, dismiss the subject of the formation of our Society, without a hearty acknowledgement of the kindness and encouragement received by myself and my fellow-workers, from you and your able colleagues when our plan was first mentioned to you. As a body, we shall not easily forget the valuable assistance you then rendered us ; and from myself, personally, your kind and friendly advice on all occasions calls for a still warmer acknowledgment.

I am aware that in France, and, indeed, throughout Europe, an impression prevails that the science of Anthropology is now formally recognised in this country. That this is correct to a certain extent, is proved by the flourishing condition of the London Anthropological Society. Still, after what I have before stated, you will not be surprised to learn that there are some eminent scientific men in England who believe, or profess to believe, that the sciences of Anthropology and Ethnology are identical. I feel ashamed to mention, that at the last annual meeting of the British Association for the Advancement of Science, at Bath, it was not only contended that Anthropology and Ethnology were synonymous terms, and that both sciences had the same aim and object, but recognition was denied to Anthropology as a science, on the plea that Ethnology was an *older*

and a *prettier* word! These were the profound reasons assigned for the exclusion of a science represented by a society, which numbers nearly five hundred members, from the yearly scientific congress of the country.

You will thus perceive, my dear colleague, that as yet this country is behind your own in the appreciation of our science, although some progress has been made in this direction during the past few years. We shall, therefore, still look to you for encouragement and assistance, and so long as we receive your sympathy in our work, we shall not fail to labour. We shall not, of course, rest until a formal recognition of our science is afforded to us by the British Association, and I know we may rely on your kind assistance to promote this end. We are confident that a full recognition must come in time, but we would gladly be spared the contention and ill feeling which are both prejudicial and derogatory to scientific men.

I will not enlarge here, my dear sir, either on your future work or our own. May you long live to further the cause of science, and to deserve the gratitude and esteem of your fellow-workers, and especially of

Your faithful and obliged Colleague,

JAMES HUNT.

Ore House, near Hastings,

November 28th, 1864.

EDITOR'S PREFACE.

THE great reputation which Professor Vogt enjoys in Germany as a naturalist and as an independent thinker, and the favourable reception of many of his works* by the scientific men of Europe, has induced the Council of the Anthropological Society of London to publish, with the sanction of the author, a translation of his recent work entitled "*Vorlesungen über den Menschen, seine Stellung in der Schöpfung und in der Geschichte der Erde.*"

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* As none of Professor Vogt's works have, to my knowledge, been translated into English, it may, perhaps, not be out of place to give here a biographical sketch of our author, which is condensed from Meyer's "*Grosses Conversations Lexicon*:"—

Carl Vogt, the eminent naturalist and parliamentary orator, was born at Giessen, July 5, 1817. He received his education first at the Gymnasium, and subsequently at the University of Giessen, where he studied chemistry under Liebig. In 1835, he followed his father—the celebrated author of *Pharmaco-Dynamics*—to Berne, where he studied physiology under Valentin. Having taken his degree as Doctor of Medicine, he repaired to Neufchâtel, where he pursued the study of zoology and geology in conjunction with Agassiz. He then, on the recommendation of Liebig, became Professor of Zoology in the University of Giessen, which he left on the breaking out of the revolution of 1848. Having been elected a member of the German Parliament, where he always voted with the opposition, he fled, after the failure of the Baden insurrection, to Switzerland, settled at Berne, until he was, in 1852, appointed Professor of Geology in the University of Geneva. Besides numerous contributions to scientific journals, Professor Vogt is the author of many sterling works, among which are the following:—*Recherches sur l'embryogénie de Salmones*, 1843; *Im Gebirg und auf den Gletschern*, 1844; *Lehrbuch der Geologie und Petrefaktenkunde*, 1846; *Ocean und Mittelmeer*, 1847; *Untersuchungen über Thierstaaten*, 1851; *Zoologische Briefe: Lehrbuch der Zoologie*, 1853-51, 2 vols.; *Bilder aus dem Thierleben*, 1852; *Köhlerglaube und Wissenschaft*, 1855; *Die Künstliche Fischzucht*, 1859; *Grundriss der Geologie*, 1860.

One of the great objects contemplated by the Anthropological Society is the publication in the English language of all important foreign works bearing on the present state of the science of man. It was considered by the Council of the Society that this work afforded a good illustration of the popular treatment of Anthropology in Germany, and that it contained facts so useful to the student as to warrant its publication. And here it may be stated, that whilst the presence of so-called sceptical opinions will *per se* never induce the Anthropological Society to publish a work under its auspices, neither will such views, according to the catholic principles upon which the society is founded, prove a bar to the introduction to the public of a work otherwise valuable. It is especially necessary to mention this, on account of the polemical character of parts of the present work. The author is not simply a fearless writer, but his tone will, I imagine, occasionally be offensive both to the general and scientific reader. I had some conversation with Professor Vogt on this subject, and he gave his sanction to such alteration being made as I thought most desirable. I accordingly omitted a few passages which I did not think in good taste. On proceeding with my labour I found that to cancel all the passages which might offend, would be entirely to alter the character of the work; these few passages have therefore been printed as an appendix. I, moreover, felt that the author had entrusted me with a most dangerous power, which, if abused, would, render the translations published by the society comparatively useless. The Fellows of the Anthropological Society of London are happily neither women nor children; and I have not, therefore, felt it my duty to encumber the work with notes expressive of my views on matters of

opinion, and thus become, in addition to editor, critic and commentator. If the work had not been published under the auspices of the society, I might have felt it my duty to state where I differed from the author; but under actual circumstances, I have only done so when I considered there was an absolute necessity, or where the discovery of new facts had invalidated the author's conclusions.

Nor do I think it necessary here to advance my own views respecting some Anthropological questions upon which this work treats. I need only say that I am willing to accept such of the facts as shall on future inquiry prove to be true. Possibly, no man will agree with all the conclusions arrived at by Professor Vogt, but I am quite ready to accept such of his opinions as can be logically deduced from well-ascertained facts.

While, however, I hold both myself and the society entirely free from any responsibility as to the author's asserted facts or deductions, I should not be doing my duty as Editor if I were not to make some excuse for the attacks made by him on theological dogmas. In Germany men of science and theologians look upon one another with a mutual contempt, while in this country scientific men entertain respect for theologians, and the latter fortunately have a profound admiration for students of science, and (when properly educated) have not the effrontery to combat the teachings of pure inductive science. In Germany, too, science is used as a political engine to overthrow the arrogant assumptions of kingcraft and priestcraft, from the evil influence of which we now in England suffer little.

If M. Vogt had been an Englishman I should certainly have highly censured a man of such profound and extensive views for wasting his energies in attacking

the opinions of theologians (as such) respecting scientific facts or scientific deductions.

Sometimes the author conveys the impression that he writes merely with a view of destroying belief in generally received theological dogmas. I cannot think this impression to be well founded, and the list of his published writings will show that M. Vogt has really been a hard-working scientific student. Scientific men naturally have a contempt for those who study theology with a view to attack the deductions of men of science : but it is equally contemptible for a man to study and write on science with the view to overthrow theological dogmas. The search after truth is the only object the scientific student ought to keep in view.

The author of this work will have the misfortune to find opponents amongst those who agree with, and those who differ from, him. M. Vogt expresses himself with very great freedom when he happens to differ from any of his scientific brethren, and the exposure of the foibles of his fellow-workers seems to afford him infinite pleasure and satisfaction. But all who know the author will entirely acquit him of malice ; and his conduct, unlike that evinced in some of the quarrels of scientific men in this country, is not the result of bad temper.

At the same time I cannot but express my regret that the accomplished author has spoken of our much respected countryman, Professor Owen, in the manner he has done. I equally regret his remarks on Dr. Pruner-Bey and M. A. de Quatrefages, and dissent from his interpretation of the conduct of Dr. Falconer respecting the Abbeville jaw. I think, also, that Prof. Vogt has not sufficiently acknowledged his obligations to many English men of science, amongst whom I would especially name Mr. Prestwich,

Sir Charles Lyell, and Mr. John Evans. Had the work assumed a more systematic form, this, perhaps, would not have happened.

In Lecture X it will be seen that the author has unfortunately accepted the wild speculation of Professor Huxley respecting the resemblance of the Neanderthal calvaria to that of the Australian. The important observations of Dr. Barnard Davis respecting the synostotic condition of this fragment bid fair to solve the question by showing that the Neanderthal skull is merely an abnormal relic, and that all the theories founded thereon as to the extreme savage state of the primitive inhabitants of Europe are utterly worthless.

Prof. Vogt acknowledges that, to a great extent, he is willing to accept the conclusions of England's great modern naturalist, Charles Darwin ; but, unlike many of that profound observer's followers in this country, he entirely repudiates the opinions respecting man's unity of origin which a section of Darwinites in this country are now endeavouring to promulgate. The author's views on this point I hold, in the present state of science, to be especially sound and philosophical: and I hope that this work may help to counteract the inconsistent and antiquated doctrines now being taught by one of our government Professors respecting the small distinction which exists between the members of the genus *Homo.*

Nor is the author, like some of our fellow countrymen, afraid to accept the logical consequences of his opinions respecting transmutation and development. On the contrary, none can charge M. Vogt with ambiguity as to his real sentiments. From his opponents I hope he will receive the credit of being honest and open in the expression of his opinions, although few may agree with

the tone he adopts. I think, moreover, M. Vogt is a less dangerous foe to the generally received theological opinions of the day, than some other men of science, who express themselves with more reserve, but with far less honesty.

The scope of the present work is great, and the author treats his subject with such a comprehensive grasp, and in such an interesting manner, that he can scarcely fail to elicit the admiration of both friend and foe.

It must be strictly borne in mind that this work is not put forward as a text-book on the subject, but simply as a specimen of the popular treatment of Anthropology in Germany, and, in my opinion, it contrasts very favourably with anything of a similar nature which has appeared in this country.

The woodcuts are chiefly those used in the original, the exceptions being a drawing of the Abbeville jaw, which in the German version was taken from the sketch of M. Oswald Dimpre, but which has now been cut from a photograph presented to the Anthropological Society by M. A. de Quatrefages. The delineation of the sutures in the woodcut of the Neanderthal calvaria in Lecture XIII, has also been altered to agree with the description sent by Dr. Fuhlrott to Dr. Barnard Davis.

In the present translation, the German text (with the exception of some corrections and additions by the author) has been followed as closely as possible : but there were some forms of expression, so utterly intractable when attempted to be rendered into English, that when intelligible, they have been sometimes adopted in preference to the removal of all traces of foreign idiom and colouring. In works of this description it is advisable to render, not

merely the substance of the author's opinion, but also, to some extent, the mode in which he conveys them.

In conclusion, I would beg to remind the reader that the present translation is one of a large and extensive series of works, some of which contain opinions diametrically opposed to the conclusions of this book. The Council of the Anthropological Society, having allotted to each Fellow who is willing to undertake the task, a volume for translation, it has afforded me great pleasure to assist in such a vast project, which cannot fail to give considerable impulse to the study of Anthropology in this country. I am aware there are some men in England who totally object to this free-trade in science, and who believe themselves authorities on certain scientific questions, and that no one else should dare to enter upon what they consider to be their preserves. I hope that this book may help to demolish such feudal ideas, which are totally unworthy of the lover of truth and science.

I hope that my readers will agree with me that Prof. Vogt has produced a most interesting, suggestive, and useful volume; and one which I trust may assist in the elucidation of some of the great problems of Anthropological Science.

4, *St. Martin's Place, Trafalgar Square,*
London. December 1*st,* 1864.

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AUTHOR'S PREFACE.

One of the objects of the Useful-Knowledge Society of the canton of Neufchâtel is to advance popular education by means of public lectures, which are delivered during the winter, not merely in Neufchâtel—the chief town—but also in the industrious Jura, in *Locle, Chaux-de-fonds,* and the valley of *Travers,* as well as in the villages on the wine-producing slopes of the lake, in all which places they are attended by intelligent and attentive audiences. Natural science, the history of Switzerland, political economy, and social life, are the chief subjects treated of. In localities where spacious rooms cannot be obtained, the use of the church is readily granted; nor has it occurred to any one to consider this a desecration any more than the Icelander objects to the stranger finding a night's shelter in the church. The success of this Useful-Knowledge Society, it is true, only dates from the period when Neufchâtel, having ceased to be a Prussian principality, became a canton of the Swiss Confederation. It is very probable that, in that happy period when a Prussian general, with a few knights of the red eagle governed the country, the lamentations of those, who condemn every result of science which does not agree with the ancient Jewish lawbook, would have prevailed and suppressed this society.

The invitation of the Society to deliver some lectures on subjects at present engaging my attention, induced me to give to my investigations the present form. The subject-matter is connected with those studies which, though with many interruptions, I have continued since the time of the struggles to which *Köhlerglaube und Wissenschaft** owes its origin. I cannot deny

* *Superstition and Science,* a controversial work by the author, which has passed through four editions in Germany.—Editor.

that since that time some of my views have undergone a partial change, not on the main points, but only upon secondary questions, which in their very change but confirm former results.

Whilst preparing the first part of these lectures for publication, I had an opportunity of making use of two recent works treating of the same subject. The one, Sir Charles Lyell's *Antiquity of Man*, the other, Professor Huxley's instructive and attractive treatise, *Man's Place in Nature*. Lyell's book afforded me the pleasure of seeing the Glacial theory, which at Göttingen is to be buried again, revived and acknowledged by such high authority. There is also found in it a collation, though a somewhat imperfect one, of facts which undeniably establish the high antiquity of man upon the globe. I have been enabled in the second part of this work to offer additional facts, owing to the steady support of my scientific friends, Aeby, Claparède, Desor, Fuhlrott, Gastaldi, His, Huxley, Morlot, Pictet, Quatrefages, Spring, Valentin, Broca, Busk, Collomb, Keller, Messikomer, Schild, and Schwab. It was, moreover, my good fortune to be permitted to examine and to take the outlines of the only two perfect skulls which have hitherto been found associated with the reindeer and the aurochs in caverns. I am indebted for the use of these invaluable relics to the kindness of their discoverer and owner, Dr. Garrigou, of Toulouse, who was so obliging as to bring the skulls to Geneva himself.

As the printing of this work, which was published in Germany in parts, was somewhat delayed, opportunity was afforded me to correct it and render it more complete in several particulars, partly by further researches of my own, partly by further communications from my friends. The additions and remarks thus rendered necessary in the German edition have been incorporated in the text of the English translation.

But during this time attacks have not been wanting—we must always be prepared for them. If they grow out of a scientific soil, they cannot but be useful, by laying bare weak points and stimulating to their correction; but if they proceed from that soil, from which the lilies of innocence and the palms of conciliation should spring up, where, however, nothing but the

marsh-trefoil of credulity and the poisonous water-hemlock of calumniation grow, they deserve no attention.

M. Frederic de Rougement, one of the champions of Prussia, in Neufchâtel, has relieved his oppressed heart by an indignant outcry, under the title, *Man and the Ape, or Modern Materialism.* This publication has, I believe, been translated into German, and published by the Missionary Society of Neufchâtel. Whoever takes an interest in it, may read the history of a storm in a tumbler of water, and how the indignation of the faithful of Neufchâtel, caused by my lectures, subsided after hearing the prelections of Rougemont.

Rougemont and myself are old acquaintances. More than twenty years ago I saw him mount the rostrum—"the Deluge" under his arm—to refute Dubois de Montpereux and Agassiz, who looked upon Noah's flood as a local phenomenon of Armenia. I then heard him at a public lecture explain the creation of Eve from Adam's rib, and why God, in his infinite wisdom, had selected the rib in particular, and no other part of Adam's body. "He took no piece of the head—woman would then have had too much intelligence; he took no piece of the legs—woman would have been too much on the move; he took a piece near the heart, that woman should be all love"!

It would, perhaps, have required more profound investigations than Rougemont can command to refute my views from a scientific standpoint. He preferred, therefore, to make an attack on Materialism on general grounds. The description of the monstrous doctrines of this modern aberration is taken from the book of a certain Boehner. At first I imagined this to be a misprint for Büchner, when, to my astonishment, I found that it was the production of a parson, directed against Materialism. This appears to me as if one were to take Luther's doctrines from the works of Eck and then proceed to confute them.

It is written altogether in the old manner. The world, history, morality, the whole structure of moral order perishes—just as during the ages of superstition; only rattling skeletons have by M. de Rougemont been advantageously replaced by

offensive corpses, which the Materialists trade in and make manure of. I see no other difference.

M. Schleiden, who so successfully combated Materialism in Dresden, that he converted his whole audience to it, also felt bound to read a lecture on man. In spite of all the trouble I took, I derived no instruction from it, merely finding in it some newspaper paragraphs seasoned with Fries' philosophical sauce.

The reader will observe that I have strictly confined myself to the animal kingdom, and specially to such animals as stand next to man, and have entirely omitted the vegetable kingdom, with which I confess I am not so conversant. Had I included plants, I certainly should not have neglected to mention two most important treatises which have recently appeared in favour of Darwin's theory. I allude to A. de Candolle's *Treatise on Oaks*, and Naudin's prize essay on *Hybridity in the Vegetable Kingdom*. Both arrive at the conclusion that species have arisen, and still arise, from each other by modification. Naudin expressly states, that variety, race, and species are merely different terms designating progressive changes, the intimate connection of which is undeniable. When one of the greatest experts in the investigation of species, after a most careful examination of the various species of oak, and supported by colossal materials, arrives at the same conclusion as an industrious naturalist who has tried thousands of crossings, and specially devoted himself to the production of hybrids, the Darwinian theory must be more than an ingenious dream, and less destructive of science than certain zealots are apt to believe.

The Anthropological Society of London, on the publication of the first part of these lectures, did me the honour of nominating me one of its Corresponding Members, and subsequently expressed a wish that the English edition of the book should appear under its auspices. To this Society, which prosecutes important scientific subjects with such great zeal, I feel bound to express my warm thanks, and more especially to its President, Dr. James Hunt, and its Foreign Secretary, Mr. Alfred Higgins.

C. VOGT.

London, April 4th, 1864.

LECTURE I.

Introduction.—Difficulties of the subject.—Materials.—Collections of Crania.—Skeletons.—Anatomy of the Races.—Man to be studied like any other Mammal.—Objections of Theologians.—Morton and Bachman.—Comparative Study of Domestic Animals.—Antiquity of the Human Species.—Objections of Naturalists.—Researches of Boucher de Perthes.

Gentlemen,—Surely there is not a more inciting subject than the study of man himself. Involuntarily we apply to all our actions the knowledge of man, long ago insisted upon by the oracle of Delphi. It is the starting-point from which we proceed, and the standard by which we measure the phenomena occurring in nature. But as it frequently happens to the inhabitant of any particular region, that he neglects the curiosities of the spot where he was born and nurtured, to which the stranger pays especial attention; so most persons neglect to fathom their own nature, and thus fail to establish a basis for further progress. There are but few who search out man; not, indeed, like the ancient philosopher, lantern in hand, and only in the market-place, but everywhere; and there are still fewer who dare to give a candid and unvarnished account of the results of their investigations. Most men look upon themselves as incarnations of the generic idea *man*, and remain under the delusion that they know themselves. The same phenomenon occurs in the history of science. In ancient times, the science of man was limited to the inquiry into some particular functions of his organism and the action of the brain. The material basis was only occasionally and superficially considered, like the region in which man lived. It is only with great trouble that we can collect from ancient authors a few scattered notices, which may throw some light on questions now deemed of the greatest importance. The opening of a single grave containing a well-preserved skeleton, arms, and ornaments, affords more information

as regards the physical and mental condition of the people to which the exhumed belonged, than ten authors of antiquity who may have described that people. It is only by degrees that we have been led to search for a proper basis on which to found the science of man.

The object which I have proposed to myself in these lectures is, to make you acquainted with the latest results obtained from the study of the natural history of man, with his relation to other animals, his antiquity upon the globe, and the primitive state of the human species. Many of these questions I have already aphoristically touched upon in a polemical treatise, published some years ago. If this treatise had no other merit, it at any rate opened questions which are intentionally passed over in silence, or made party questions. As is well known, an Athenian legislator imposed a fine on any citizen who did not profess to belong to some political party. Similarly there occur periods in the history of science, when public opinion forces the inquirer to espouse a party, and neglect is followed by punishment. For inquiry *per se*, yielding neither results nor increase of the knowledge of mankind, seems to me as little meritorious as the digging of a hypochondriac which has for its sole object to equalise the circulation of his blood. It is only when digging the soil leads to the production of fruit, that it becomes meritorious.

The questions I intend to discuss offer peculiar difficulties, to which I must draw your attention, lest from the paucity of the results you should hastily draw the conclusion that insufficient pains have been taken to elucidate certain points. The study of the natural history of man, like a giant with a thousand arms, embraces almost every branch of human knowledge, and the deeper we penetrate, the more intricate appear the paths which may lead to the goal. The subject is not man, considered as an abstract being: the inquiry extends to millions of men scattered over the earth, their physical peculiarities, their present and former relations to each other, and stretches back to a time when man scarcely left more traces of his existence than the savage beast which inhabited the same region. From the results obtained we must, then, draw inferences con-

cerning the relations of the races of mankind to each other, their intermixture, their descent and propagation, their relation to other creatures, especially to the higher mammals; and also, the changes which air, climate, and mode of life, have produced in man in his struggle for existence.

It is clear that the difficulties attending an investigation of this kind are very great, so that in spite of all efforts we are only on the threshold of our inquiry. Man is scattered all over the globe, and everywhere, even in the remotest regions, numerous intermixtures have taken place, by which the possibly original purity has been more or less impaired. Moreover, a science, if it is to draw unimpeachable inferences, requires fundamental principles mathematically certain, and these can, in this our field, be but very slowly obtained. Direct investigation can only be applied to individuals. If we have to determine the characteristics of a tribe, a people, a race, a species, we can only ascertain them by taking the mean of numerous observations and measurements of individuals. We all know that the characteristic peculiarities of a people, the Germans and French, for instance, cannot be determined from a superficial acquaintance with single individuals at a *table d'hôte,* but that a long intercourse with all the various classes of a nation is requisite for the formation of a proper estimate. And yet here we have only an individual perception of peculiarities for which there is no certain standard, the estimate of which frequently depends on the disposition of the observer. But when, as in our case, we have to do with physical peculiarities, actual measurement comes into play, and it alone can lead to useful results. The first step is to examine the whole physical conformation, especially the most characteristic parts; head, skull, brain, hand, and foot: not in a few, but in a great many individuals, and in this way to eliminate individual peculiarities, and give prominence to such as are common to the great majority. Now, anyone who knows the difficulties we meet with in this respect, even in our civilised countries, where the materials are at hand, will readily conceive that they are increased when such inquiries are to be carried on in distant regions among savage nations. Quêtelet, the eminent director of the Brussels Observatory, has been occu-

pied many years in investigating, with meter and balance, the laws of human growth in Belgium, and in thus constructing, so to speak, what he calls "the average man," as obtained from the mean of a great number of individual observations. And yet these measurements and weights apply only to a small stock, inhabiting but a little corner of the globe, and exhibiting but few of the relative proportions of the bodily organs.

Very recently, Professor Welcker of Halle has attempted to construct, from a comparatively small number of crania, the normal skull of the Germanic stock, or in other words, to find out the peculiarities belonging to most German skulls; and though thirty normal male, and as many female skulls have been measured and registered, still this number is not sufficient to yield an absolutely certain average. Recollect, now, that investigations of the same nature as these, which required years, though confined to a small district, are to be extended to all parts of the globe, with a view to the acquisition of such data as we possess with respect to Belgian recruits and German skulls, and contrast with this the inadequacy of the means we at present possess of obtaining the materials needful for our inquiry. The travelling naturalist, even when he sails in the Novara, under the Austrian flag, may congratulate himself if here and there soldiers, porters, sailors, or loose women offer themselves for examination, or if the chiefs of some tribes allow themselves to be photographed. In southern parts, where nakedness is not deemed indecent, observation is in this respect facilitated; but in the north, where the climate forces man to cover the body with skins night and day, as among the Esquimaux, Samoiedes, and Tschuktshes, permission to view the naked body is not so readily conceded. And finally, where shall we find naturalists dwelling for many years among foreign races, in order to secure opportunities for comparative researches?

We shall see in the course of these lectures, that the cranium, the most important part of the osseous system, containing as it does the organ of the mind, deserves the closest examination. Many naturalists, like Blumenbach at Göttingen, Morton in America, and others, have devoted much of their time to the formation of collections of crania, representing the various types

and races of mankind. Even here the difficulties we meet with are great. It is hardly feasible in the times we live in to cut off the heads of the living; and to despoil the graves of the dead is in most civilised countries considered a crime, and severely punished. Pious ignorance even now declaims against dissection, and it is not so very long since English anatomists were driven to employ resurrection-men, and were indirectly the cause of murders being committed. We must, therefore, not wonder that the procuring of skulls in uncivilised countries is not unattended with danger, and that we succeed only in exceptional cases in collecting a sufficient number of skulls of any stock to enable us to draw just inferences from comparison.

The industry and perseverance of some observers have brought together comparatively large collections of crania, of which, however, the origin is frequently doubtful. Thus, for instance, it is frequently impossible to say definitely whether the skull is that of a male or female; and yet the differences between the male and female skull are not insignificant. In the more civilised races the difference is as great as between the skulls of the same sex in different races; and, as there is but little difference in this respect in the Negro and other inferior races, the determination of the sex becomes more uncertain as we approach the inferior races of humanity.

As regards the rest of the skeleton, the materials become still more scanty. It is easy to carry off skulls, but a skeleton requires more care. Nine out of every ten sailors still believe that a skeleton or a coffin on board brings bad luck, and under such circumstances they are apt to mutiny if a storm breaks out. And yet many parts of the skeleton require to be examined, such as the structure of the hands, feet, the form of the pelvis, —all these can only be determined by numerous observations.

The skull is chiefly important from its investing the brain so closely, that its chief features are impressed on the inner surface of the cranium. The brain deserves, above all, a close investigation, in examining the organisation of thinking beings. It has even been proposed to classify mammals according to their cerebral structure. The ideal of an anatomy of races, which Professor Wagner, of Göttingen, promises the public in the

preface of every new work he publishes, but which seems not to have advanced further than a collection of materials, such an ideal, I repeat, would undoubtedly comprise a close examination of all racial brains, founded on minute dissection. But we are as yet far from such a consummation. Here and there some European anatomist succeeds in obtaining a black subject for dissection, but want of acquaintance with his genealogy, which can only be traced through one or two generations* of slaves imported from Africa, may give rise to the suspicion that transportation into another climate, and the change in mode of life and civilisation, may already have modified the original structure of the body, and specially of the brain as the organ of mental activity.

You will from these few remarks easily form some conception of the difficulties under which the naturalist labours, in the process of determining not merely the physical but also the psychological nature of man. The material is only obtained in scanty fragments, and these are capable of elaboration in so many different ways, that the labours of predecessors cannot always be appropriated.

When, having overcome these difficulties and procured some materials, we try to apply the results obtained, there rise from the depth of society other phantoms which must be combated. The whole inherent pride of human nature revolts at the idea that the lord of the creation is to be treated like any other natural object.† No sooner does the naturalist discover the resemblance of some higher mammals, such as the ape, to man, than there is a general outcry against the presumptuous audacity that ventures to touch man in his inmost sanctuary. The whole fraternity of philosophers, who have never seen monkeys except in zoological gardens, at once mount the high horse, and appeal to the mind, the soul, to reason, to consciousness, and to all the rest of the innate faculties of man, as they are refracted in their own philosophical prisms. This mode of

* And even then with no certainty.—EDITOR.

† This, no doubt, is quite true of the masses of mankind; but such feelings are not shared in by either the philosophic or the truly scientific mind.—EDITOR.

reasoning resembles that of my old teacher Wilbrand, in Giessen, who until his death, which took place about twenty years ago, protested against the circulation of the blood. "Which," he asked, on examining a candidate for honours, "is more preferable—the mental or the physical eye?" Woe to the candidate who replied "the bodily eye:" he was plucked at once. Of necessity the candidate answered the mind's eye. "Well, then," continued the professor, "mental inspection must be superior to physical inspection; if, therefore, you say that you have, by the aid of the microscope, seen the circulation of the blood with your bodily eye, and I tell you that I have seen the impossibility of the circulation with my mind's eye, it follows that I am right and you are wrong." In the same way our philosophers observe with the mind's eye, and when they call to their aid the imagination, which, according to Carrière, "is a direct inspiration from above—which perceives the divine thoughts in nature, and represents a transition of universal thoughts into the thought of the individual:" when, I say, these imaginative philosophers, come forth as God-inspired prophets, we, ordinary mortals, must bow down our heads, and confess that our results are only the fruit of human labour, and not the emanations from a supreme being entirely unknown to us.

These idle speculations have had the effect of confusing and perplexing even unprejudiced inquirers, so that we meet with the most striking contradictions, and must take every possible care that we do not fall into them ourselves. A kind of system of double entry, much lauded formerly though with small success, makes again its appearance under a different form. Thus we find that the same naturalist declares in the same page, that the physical differences between man and the ape are just sufficient to constitute mankind a family which must be placed at the head of the order of apes; whilst, on the other hand, man's intellectual faculties are so essentially distinct, that he must form a separate kingdom, like the animal and vegetable kingdom.* In order to show you the contradictions that arise in this

* Quatrefages.—EDITOR.

matter, when we abandon the basis of exact science, I will just quote the opinion of another not less celebrated naturalist, who opines that the mental faculties of a chimpanzee compared with those of a Bosjesman* exhibit only a difference in degree, but that the structure of the human brain differs greatly from that of the ape.† These opposite views proceeded solely from the desire to place man above the ape.‡ The one of these inquirers has forgotten to tell us how it is possible that man with a monkey brain could conceive human thoughts; and the second has not told us how a human brain can produce apish thoughts. If the brain be the organ of the mind, the function must always be consonant with the structure.

This is only one aspect of the question. If the human species, as it is scattered over the globe, be considered as a whole, we are immediately struck by the differences which the various races exhibit. There can be no doubt that the investigation of these differences is within the province of the naturalist, and, however much our pride may revolt against it, there is no other method than that followed in zoology. The degree of the variations is very important, as it furnishes us with a standard for ascertaining the relations in which the various races stand to each other. This we shall illustrate by an example. Cats, like the human race, are found in all parts of the world; every where, excepting in the extreme north, we find beasts of prey belonging to this type. But at the first glance we perceive that they greatly differ. No man will confound lions, tigers, panthers, cats, and lynxes, and it is just as impossible to confound Negroes, Mongolians, and Caucasians. On close examination, however, there occur in the feline family, as well as in the human family, intermediate types, which engender doubts. The spotted cats,

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* This is an allusion to a note inserted by Prof. Owen in the *Journal of the Proceedings of the Linnean Society for* 1857, p. 20. The author's words are that we are unable to "appreciate, or conceive of the distinction between the psychical phenomena of a chimpanzee and of a Bosjesman, or of an Aztec with arrested brain growth." The comparison is therefore made between the psychological phenomena of the chimpanzee and the Bosjesman "with arrested brain growth," and not between the chimpanzee and the Bosjesman in a normal state.—Editor.

† R. Owen.—Editor.

‡ An author may hold such opinions without any "desire" to place man above the ape.—Editor.

which were formerly included in the panther type, run into a variety of forms, which differ, more or less, in the number and arrangement of the spots, the length and hairiness of the tail, the variations in the dental system and the skull; in short, by a variety of marks known only to the minute observer, which, however, enable the inquirer with more or less certainty to determine whether they are merely accidental variations or permanent forms. Let us confess at once, that, in all wild animals, the estimation of these variations, and their consequent classification, depends much on the predilections of the observer, so that what one declares to be a species another takes to be only a variety. The accumulation of facts leads generally to the result, that some decidedly different forms are laid down as species, round which the less differing forms are grouped as varieties. Though the validity of many species is still discussed, and though many definitions of species have been given without any satisfactory result, still these discussions stimulate the progress of science.

It is somewhat different as regards the science of man: here was a field in which the result at which science was to arrive was prescribed. *One* Adam, *one* ancestor, *one* Noah with three sons as secondary ancestors—these were the premises forced upon scientific inquiry, without the assumption of which the naturalist was unceremoniously sent to a place we need not mention. In the former case we had to do with philosophers, who in their academical gowns only talk to a select audience, but here we had against us the whole clergy, with their faithful sheep and butting rams—a state of things which can only be appreciated from experience. Do not think that I only speak from my own experience. Dr. Morton, an eminent name among naturalists, an esteemed physician of Philadelphia, devoted himself to the study of American craniology. After many years study he arrived at the conclusion that the human family consisted of distinct species, and could not possibly have descended from the same Adam, and this result he published. A parson, the Rev. Dr. Bachman, in Charleston, took great offence at this. As is the custom with priests, Bachman first writes a friendly letter to Morton, informing him that, being of a different opinion, it

will be his duty to write against him, but hoping that this will not interrupt their friendship, as he still considers his friend Morton an ornament to science. Dr. Bachman straightway publishes a work in which he clearly betrays the greatest ignorance of the subject. But what is this to a man full of faith? In spite of his ignorance, his reverence arrogantly attacks Morton, as his biographer says, in a bombastic and declamatory style. Morton replies in gentlemanly dignified terms, repeating his arguments, and sustaining them scientifically. This greatly irritates his reverence; he now accuses Morton of being at the head of a conspiracy which had its branches in four cities of the Union, and whose sole object was the overthrow of a doctrine closely connected with the faith and hope of the Christian for this world and for eternity. Infidelity, he continues, was the necessary result of Morton's views, which must be energetically opposed. This took place in 1850. Morton's death in the following spring put an end to the dispute; but do we not hear similar sounds from Goettingen, and are they not the echo of the priestly objurgation wafted across the Atlantic Ocean?

The question with regard to the differences of human races not merely affects the basis of theology, but the most interesting and difficult problems of natural history. When we have to decide whether these differences are original, or acquired in the lapse of time, the closest examination is requisite, not merely as to man's historical development upon the globe, but as to the influence of surrounding media. We must ascertain what may be the effect of the climate and the mode of life to which man may be exposed in his migrations; how far deficiency or abundance of aliment, certain habits, the gradual elevation to a higher civilisation may have changed the original character, or entirely effaced it, so as to be no longer recognisable; how far intermixture between several races, intentional or accidental, may have given rise to new forms. Here it is not man alone who is to be considered, but other creatures, specially the domestic animals which are im-

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* For particulars of these statements see Dr. Patterson's Memoir of Morton, in *Types of Mankind*, p. 53.—Editor.

mediately under man's control, and the forms of which he endeavours to alter according to his wants.

This part of the question—perhaps the most interesting—has given rise to the greatest controversy. Very recently this subject has again been handled by Darwin, the eminent naturalist, and we shall in the sequel have to treat of his theory of the origin of species. Here I may say this much, that, though I do not adopt this theory with all its inferences, it yet appears to me to be nearer the truth than any other, and I do not hesitate to say that I accept it with regard to nearly allied types.

I have already observed that our question has also its historical, or, if you like, its geological side, which cannot be neglected, although we again run the danger of turning the milk of human kindness into poison, and Christian love into grim hatred. When we desire to study the influence which the natural conditions exercise upon man, we must go back as far as possible into the history of the human race, since the lapse of time is a factor which must always be kept in view. We must necessarily form an alliance, not merely with the historian and antiquary, but with the geologist; we must appropriate their results, and apply these to the solution of our problem. Here, also, the difficulties are numerous. The delusions and mystifications to which antiquaries are exposed, have yielded materials to the novelist. But in this maze the right path has been detected; and as the testimony of Egyptian antiquities shows that the civilisation of mankind reaches further back than the period assigned to Adam by the Jewish lawgiver, we are at once justified in declaring that the antiquity of man reaches back to a period when extinct animals peopled our continent, and that this period exhibits a state of civilisation which can scarcely bear comparison with that of the aborigines of Australia.

One might suppose that the question regarding the antiquity of man on the globe concerns science only; such, however, does not seem to be the case. The Christian theologian immediately discovers that it is a mere presumption of the

layman to assign to the Mosaic Adam a recent period in history, and to assert that there had existed a previous civilisation, in which man knew not the use of metals, and prepared his tools and weapons from flints and bones.

We must not, however, lay the blame altogether on theologians; the reproach must also be extended to the representatives of science, though in a lesser degree. In consequence of the dicta of some eminent naturalists at the time when the facts were less numerous, the opinion generally prevailed that man belonged to the most recent geological epoch, and had only existed in the present condition of the globe. The remains of extinct animals intermixed with human bones, had, no doubt, been found; but these facts had either been ignored, or very indifferently investigated. To such an extent did the belief in the late appearance of the higher animals prevail, that the existence of fossil apes in the tertiary strata was denied.* Soon, however, the facts accumulated, and they were all the more readily accepted as they were thought to relate to apes only. Just read the lamentations of that enthusiastic inquirer Boucher de Perthes, as to the trouble he had to induce some few unprejudiced naturalists merely to inspect the beds from which he extracted flint hatchets. "Practical people," he observes, "smiled, shrugged their shoulders, and would not look at the implements; in one word, they were afraid of a heresy. And when the facts became so patent, that each could verify them for himself, I met," says he, "with a greater obstacle than opposition, sarcasm, and persecution—the silence of contempt. The facts were no longer denied, they were buried in oblivion. Then followed explanations more wonderful than the facts themselves; the stone hatchets, it was said, were the products of fire; they had been thrown up by a volcano in a fluid state, and, falling into water, had, in cooling, assumed the shape of hatchets. Others said it was intense cold that burst the flints into fragments resembling knives and hatchets. Then, again,

* Even by Cuvier. It was not until four years after his death that the first fossil apes were discovered.—EDITOR.

that the workmen had chipped the flints and imbedded them.*
All these objections I did not much care for, but what vexed me most was, the obstinate refusal to examine the facts, and the use of the expression, 'It is impossible!' before people had taken the trouble to ascertain whether it was actually so."

The distrust with which antiquarian researches are frequently received by physicists, may have had its share in the reception which gave rise to these jeremiads. But science has no written code, and every fact finds a way for itself if zealously advocated. Boucher de Perthes at length succeeded in inducing some geologists to visit the valley of the Somme, when he showed them the flint implements *in situ*. These observers created some sensation in the learned societies of Paris and London; the subject was discussed, and the facts verified, so that there exists no longer any doubt. But in theology, Tubal-Cain still occupies his place as the first worker in metal, and whoever does not believe it is not only now and for ever lost, but is publicly branded† as an infidel.

The great antiquity of the domestic animals, and their relations to man, are of particular interest, as they exhibit more than man the influence of nature. As man can act upon them by breeding and aliment according to his will, he is enabled to alter the given forms in a manner which it seems scarcely possible could happen by natural means. If, then, in tracing the changes they have undergone since the most remote times, it could be proved that the various races into which our domestic animals are divided, are either the descendants of one original stock, or the products of intermixture between several original species, we should no doubt obtain analogies of as much value as many of the conclusions derived directly from the human species.

You observe then, Gentlemen, that the field of these in-

* See on this subject the *Anthropological Review*, vol. i, p. 80.—Editor.

† It is certainly little to the credit of our "enlightened" age, that men of science are, even in our own country, still exposed to coarse epithets and the imputation of sordid motives, if they advance any doctrines at variance with preconceived ideas. Like the Brahmin who smashed to pieces the unoffending microscope, which showed him living beings in his vegetable food; so the vehemence of such self-sufficient assailants rises in proportion as the facts advanced cannot be disproved.—Editor.

quiries is more extensive than might be supposed. It will be my object not, indeed, to touch upon all the facts, but merely upon those possessing real importance as regards the inferences to be drawn from them. In fulfilling our task we shall care very little about the dust we may raise, or about religious and political prejudices which we shall, perhaps, be obliged to take by the horns and cast aside. It concerns us very little whether the existence of Adam, Tubal-Cain, and Noah is, or is not, verified by our researches. It is indifferent to us whether the Democrats of the Southern States find in our investigations a confirmation or a refutation of their assertion,* that slavery is approved of and ordained by God; or whether the Yankee can fairly infer from our inquiries that he is quite justified in his proud refusal to sit in the same room, or to ride in the same railway carriage with the Negro, though he does not refuse to eat what the Negro has cooked. We shall advance straight forward, heedless of the yelping behind us.

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* There is no doubt that the greater part of the democrats look upon slavery as a divine institution. Many believe that it is supported by the history and teaching of the Bible. Most, however, of the slaveholders of the South look upon their slaves as a great charge which they have inherited from their forefathers. They believe that the Negro is mentally only a child, and quite incapable of living happily and naturally in juxtaposition with the white European, except in a state of complete subordination and subjection. Many slaveholders assert they would be very glad to part with their slaves, if they could be taken entirely away; but they refuse to "free" them and allow them to become a nuisance, and an eyesore.—Editor.

LECTURE II.

Method of investigation.—Mixed Types.—Average Man and Skull.—Use of the French Metrical System.—Scherzer and Schwarz's System of Measurement.—Craniometry.—Fixed Points in the Skull.—Choice of the Thinnest Places.—Busk's System of Measurement.—Aeby's System.—Horizontal and Vertical Planes.—Relation of the Skull to the Face.—Camper's Facial Angle.—Measurement of the Base and Vault of the Cranium.—Welcker's System of Measurement.—Cranial Angle; Skull; Net.—Von Baer's Nomenclature for Cranial Forms.—Coronal View: Longheads, Medium Heads, and Short Heads.—Profile View: Prognathism and Orthognathism.—Anterior and Posterior View: Tower Heads, Pyramidal Heads, and Roof Heads.—Scherzer-Schwarz's Scheme.—Tables of Cranial Measurements after Virchow, Welcker, Von Baer, and Busk.

Gentlemen,—A proper method of investigation is frequently of greater value than the investigation itself. This axiom eminently applies to natural science. A fixed plan, which will prevent digression and enable other inquirers to pursue the same path, is of special value. In speaking therefore in this place of the methods which ought to be followed in order to arrive at any results in the study of the natural history of man, I do so under the firm conviction that only an insight into the methods of investigation can enable us to estimate its results. We must, however, confess that it is only within a very recent period that investigations on a proper system have been commenced, and that some inquirers have agreed upon uniformity of method.

There can be no doubt that the object of our inquiry is subject to a variety of changes, resulting partly from individual disposition, from the lapse of time and from external influences, so that every investigation has necessarily many defects, arising from a variety of sources. The original disposition which parents transmit to their offspring, varies extremely even in children of the same father and mother—the more so the

longer the interval between the births of the offspring. The development of life from birth to death depends on many conditions, which, though following a certain law, are still subject to many oscillations. Not merely the body as a whole, but each part individually, every bone and every organ has its own law of development and decay. Sex, climate, dwelling-place, alimentation, and occupation, all have their influences. In proceeding further, other important sources of error arise which increase the difficulties. Let us, for instance, assume that we are investigating the question of human races, and that we confine our researches to the skull; that we take the German skull as a standard for measurement and comparison, as we have many of these at our disposal. But where is the guarantee that this skull, which every German anatomist may declare to be a well formed German skull, belonged to one of pure German blood? Where is the spot on German soil where there has not been, or at least might not have been, an intermixture of the most various races? Have not, from the most remote times, Asiatic and European peoples chosen Germany as their battle-field; and, as Venus always accompanies Mars, have they not left their traces in the blood of their descendants? And, independently of these invasions, are there not many districts in Germany where for centuries different tribes dwelt side by side, until both became fused, or the weaker were absorbed in the stronger? Have we not the most evident proofs that the Germans, of whose habitation in the oak forests our patriotic songs speak, were only the third invaders, who subjected and absorbed two peoples, the previous occupants of the German soil? Do not the Sclavonic historians claim two-thirds of Germany as their inheritance, from which they have been displaced by cunning and violence? Where, then, in that historical or antediluvian mixture now called Germany, is the spot where we may find the genuine, unmixed, pure German square head—the *tête carrée* as the French call it? Certainly no one can give a definite answer to this question, and every one will admit that the possibility of intermixture in preceding generations cannot be denied.

As with the Germans, so it is with every people on the

globe. Traditions, historical facts, physical peculiarities, point to extensive intermixtures, which either affected the purity of the original stock, or perhaps gave rise to a new race. How are we to get out of this maze? Can we possibly discover a method which may diminish the sources of error, and lead to more certain results?

Natural philosophy, and its allied sciences, have long since solved this problem, and it only remains to apply the same method to our investigations. Where inquiries necessarily involve many sources of errors, these can only be reduced to their minimum by frequently repeating the observations and measurements, so that we obtain from the mass of experiments an average representing a law. The greater the number of individual facts accumulated, and the more strictly they are defined, by selecting, for instance, cases of the same sex, age, and condition, the more exact will be the results. Let us illustrate this by an example. In countries where conscription is in force, all males, excepting cripples, are measured during their twenty-first year, and those are excluded who do not possess the prescribed military height. We can thus determine the average height of the males of twenty-one years of age in certain countries. It is clear that great errors would arise if only a hundred recruits were measured; for these may be, as for example, in France, either from Alsace, Brittany, or Provence, which are inhabited by three different stocks varying in stature. But after the measurement of a thousand recruits from different regions, the calculation of the mean height will be less liable to error; and by further measurement of all the conscripts of a certain year the result will be singularly near the truth. Still, even such a proceeding may prove somewhat fallacious, as a particular year may be distinguished by special peculiarities. Thus, it is a fact that during a famine fewer children are born, and these are, on the average, weaker and less developed than those born during other periods. But by extending the measurements to a number of years, even this source of error will be greatly diminished, and the result very nearly approach the truth.

I have purposely selected this example to show what striking

results may be obtained by the most unpromising means, the moment we know how to group and handle a number of data properly. It is from the recruiting tables of France that one of the most ingenious writers on the Natural History of Man, Paul Broca, has deduced the distribution of the large-sized Kimri or Gaels, and the small-sized Celts in France, and indicated the districts where these tribes have preserved their purity, and those where they have become intermixed.

You thus perceive, gentlemen, that in examining either individual characters or separate races, we must apply the principles adopted in physics, meteorology, and the allied sciences. Exact measurements and weights, expressible in figures, and applicable to numbers and masses, can alone afford a basis for scientific accuracy. Everything that rests merely upon personal predilection or individual conception must only be added as flesh and skin to the skeleton, afforded by measurement and weight. In ordinary cases, measurement and weight form the generally received standard; in others, the standard has yet to be found. Attention has rightly been called to the necessity of devising a table of colours for the estimation of the coloration of the skin and hair (like the cyanometers for the sky), in order to obviate the confusion prevailing among naturalists as regards the shades in the different races, some of which are, by one writer, described as of olive colour, and by another, as of dark coppery-brown.* It must, however, be admitted, that there are many difficulties in the preparation of standard colour-tables calculated to lead to satisfactory results.

If we are to devote our attention, before all things, to what can be measured and weighed, the living man is the first object which demands our investigation. The "average man" of Europe having been determined by Quêtelet, his system is now applied to races. Hitherto, such observations have only been made during three voyages in distant parts of the world. Burmeister applied this method, to a limited extent, to the Negroes in

* The Anthropological Society of London, acting in concert with the Paris *Société d'Anthropologie*, are about to bring out some tables of this description; and these will be accompanied by some general instructions which are to be sent to all the fellows, correspondents, and local secretaries of the society in different parts of the world.—EDITOR.

Brazil; Drs. Scherzer and Schwarz, on a large scale, during the voyage of the *Novara*; and the brothers Schlagintweit in India. Burmeister has published the results, if not the details, of his measurements; the observations of the latter travellers have, to my knowledge, not yet been published in their entirety. Since the story of the colossal idols of Thibet, the scientific reputation of the brothers Schlagintweit is not such as to warrant implicit faith in their conclusions; so that we must adopt the *Novara* expedition as the starting-point of a scientific investigation of human races in distant regions.

It is a matter of primary importance to establish a uniform standard of measurement, so that we may compare the results obtained by a variety of observers, without any necessity of reduction. Most observers, with the exception of the English,* now use—and quite properly—the French measure and weight, the metre and the kilogramme; and it is surprising that so distinguished a naturalist as Karl Ernst von Baer should adopt the English standard, which is not even fixed, some dividing the foot into ten, others into twelve, inches. By the way, gentlemen, the great reputation of the English, as practical people, rests on as small a foundation as any other flattery, and it is precisely the things of common life that prove this most evidently. During the Crimean war, we saw the stiff and formal English perish from frost and hunger, though they had abundant provisions at a small distance; whilst the more handy French, with much scantier material at their disposal, contrived to make themselves exceedingly comfortable.† It is just the same in social life. There is not a more senseless metrical and monetary system than the English. Without calculation you cannot re-

* The English have certainly hitherto used their own measures; but the inconvenience of this course is so fully appreciated by myself and brother members of the Council of the Anthropological Society of London, that we have decided to do all we can to introduce French measurements, into all our researches and investigations. The author is not, apparently, aware of the difficulty of obtaining any mutual action on the part of English men of science. The Anthropological Society—as a young institution—is fortunately free from the trammels and hereditary prejudices which too often are successful barriers to the introduction of foreign methods.—Editor.

† This is, to a great extent, true; but the causes of the great mortality of the English troops in the Crimea are also in some measure to be ascribed to the want of training of our young soldiers, a large proportion of whom besides were suffering from the effects of syphilitic disease.—Editor.

duce lines to inches, and inches to feet. The foot has no definite relation to the mile, nor the latter to the degree of latitude. Pounds, ounces, and scruples vary for different objects, just as formerly apothecary and market-weight were in use in Germany; and they, also, cannot be reduced without calculation, and have no relation to the measurements of solids and liquids. This nonsense even extends to the thermometer, the Fahrenheit scale being the only one in use. How simple, compared with all this, is the French system! How easily is it applied in making calculations and noting the results.

After this digression, let us return to our subject. It is no small task to measure a living man. On looking at the systematic scheme made use of by Scherzer and Schwarz* in the *Novara* expedition, we find that it takes several hours to note in the register the seventy-eight data required. In the general part, the age, name and sex of the individual, colour and structure of the hair, the growth of the beard, colour of the eyes, and other peculiarities, are noted first; then the number of pulsations, the strength, by means of Regnier's dynamometer, and finally, the weight and height of the naked body, are determined. Next follow the measurements of the head, the trunk, and the extremities; twenty-one of them relate to the head, seventeen to the trunk, and twenty to the extremities. I cannot particularise them here; those who wish to render them more complete, or criticise them, must make themselves familiar with them by practical manipulation. This much may be said, that the scheme gives a tolerably complete representation of the body measured, and thus attains the object in view, as far as is practicable.

The first requisite for every measurement is that fixed points should be discovered, which may easily be found in all objects of the same kind, and to determine the lines and planes from which further points may be determined. Such requisites seem at first sight very easy to obtain; but on examination they will be found attended with so many difficulties, that we need not wonder at

* I have added to this lecture Messrs. Schwarz and Scherzer's scheme, which is so arranged that every instrument is only laid aside after it has answered all its purposes.

the difference of opinion in the matter. Measurement on the living individual is, of course, only external, and we all know how human beings differ in dimensions, owing to aliment, condition of life, and constitution; as far as possible, the measurements on the living body must be confined to those parts where the bones are nearest the skin, or where apertures exist which either lead to internal organs, or present fixed positions. Let us apply this first principle to that part which is of the greatest importance to us, namely, the head. In most cases, the skull and the lower jaw are so near the skin that their shape may easily be felt. The base of the cranium alone is inaccessible, and its important proportions can only be determined on the prepared skull. Of the various apertures in the cranium, the external auditory opening is the one which supplies all the conditions required for a central point. The aperture of this canal is sufficiently narrow to render it easy to determine its centre, and it corresponds very nearly with the aperture in the dried skull, so that all measurements from this point may be transferred from the living individual to the cranium, and *vice versâ*. We may, therefore, boldly assert that any system of measurement which does not include the external auditory opening as one of its most important fundamental points, is faulty and imperfect.

The external margin of the orbit, corresponding to the outer angle of the eye; the centre of the process to which the muscles of the neck are attached; the root of the nose; the junction between the septum of the nose and the upper lip, which bears a certain relation to a bony process called the anterior nasal spine; the terminal point of the upper jaw between the two middle incisors; the central point of the projecting chin, so characteristic of man;*—all these points are easily determined in the cranium, and form a net of triangles, by means of which all other measurements may be effected. I merely indicate the principle without giving details; but you will agree with me that it is to be regretted that many recent measurements are of such a kind as to preclude their comparison with measurements on

* And some Indian monkeys.—EDITOR.

living men. Thus while von Baer, for instance, with many others, measures the diameter of the skull from the lowest point of the forehead, the so-called glabella, to the most projecting point of the occiput, Welcker takes the frontal eminences, which are situated higher up and cannot be exactly determined either in the living or the dead skull, as his starting-points, so that both these measurements are liable to great objections, both on the score of usefulness and accuracy; this much, moreover, is certain, that, even if they could be accurately determined, they are not comparable with each other.

There is another circumstance, as von Baer justly observes, which must be attended to in cranial measurements, namely, the unequal thickness of the skull in various parts, so that in order to obtain an approximative idea of the internal capacity of the cranium, we must select the points where the bone is thinnest, and avoid the prominences, which are especially liable to be modified by the action of the attached muscles.

On each side of the human skull there is a curved line, the so-called temporal ridge, which marks the limits of the temporal muscle. The more this muscle—the chief masticating muscle—is developed, the higher up is the line, and the broader the space between the zygomatic arch and the cranium. The development of this muscle is sometimes so great that in many animals its fibres have no room for attachment to the side of the skull, and a crest is formed on the vertex to serve for attachment. The development of the temporal ridge and the breadth of the zygomatic arch are, therefore, in direct proportion, both depending on the development of the temporal muscle. Now, it is this muscle which especially effects the perpendicular action of the jaw; whilst the lateral motions of the jaws, for the grinding of the food, are effected by other muscles. The latter are greatly developed in vegetable feeders, such as ruminants, whose lower jaw acts like a millstone. The perpendicular motion especially obtains in carnivora. We thus necessarily arrive at the result, that nations living chiefly on animal food exhibit more developed temporal ridges and broader curved zygomatic arches than vegetable feeders; the latter pos-

sessing, also, flatter zygomatic arches, and therefore narrower faces, and perhaps also longer skulls.* It is clear, therefore, that the advice, to avoid prominences and to select the thinnest parts of the skull, should certainly be attended to in estimating the internal capacity of the cranium; whilst, on the other hand, the development of lines and crests is of importance, as affording indications for distinguishing races. For the question may also be asked, has any given race strongly developed temporal ridges because it is carnivorous? or, is it carnivorous because of the great development of these ridges and of the muscles of mastication?

Still, it is very difficult practically to follow Von Baer's well meant advice. The thinnest part of the cranium is just the centre of the temple, which is covered by the temporal muscle: but this point, though well known even in common life from the danger attending a blow on this spot, can neither in the living nor the dead subject be determined with that accuracy requisite for measurements; whilst those spots nearest the skin generally correspond with the ridges and muscular projections. The objection which may be made to so many methods, viz., their inapplicability to both the living and dead subject, applies also to the otherwise rational method lately proposed by Professor Busk of London. This mode of measurement is based essentially upon a fixed vertical line passing through the centre of the auditory opening, and drawn from the vertex at the point where the sagittal and coronal sutures meet. The selection of the external aperture of the ear as the starting-point of the radii and angles is unobjectionable; but the perpendicular line can hardly be determined with accuracy. In many skulls the exact point can only be guessed at, as the sutures are frequently denticulated to such an extent that the exact spot in which they meet may be outside the central line, and consequently either before or behind the point. It is, moreover, impossible to find this point on the living head; and as all other lines depend upon the vertical, Busk's method of measurement can-

* This is a very ingenious theory, but must be pronounced to be as yet mere speculation.—Editor.

not be applied to the living body. It is, moreover, difficult to apply this method, as the explanations are so brief and imperfect,* notwithstanding the illustrative figures. I, however, give the table and some illustrations, as the method contains the germ of a rational system of measurement.

A new method of cranial measurement, proposed quite recently by Prof. Aeby of Berne, is founded on the use of a base line, the posterior end of which coincides with the central point of the anterior margin of the foramen magnum. The other extremity of this base line must be sought for at the anterior margin of the plate of the ethmoid, which is easily accessible in a skull sawn through longitudinally, but is more difficult to determine in the entire skull on account of the hidden position of the ethmoid bone. "Externally," says Aeby, "this point generally corresponds with the lower margin of the frontal bone, where it joins the nasal process of the superior maxillary bone; still it must be borne in mind that the suture in question may remove higher up or lower down in different individuals. The point may be obtained with great certainty by connecting the *foramina ethmoidalia* by a straight line, and producing it in front until it intersects the suture between the above-mentioned process and the lachrymal bone. Regard must be had to the possibly abnormal course of this suture. Here, then, we have the anterior end of our base line, which embraces the whole space where the cerebral and the facial portion adjoin each other." The base line obtained in this way is produced backwards and forwards, and the whole system of measurement is founded upon it. A plane placed perpendicularly upon it, longitudinally bisecting the skull, is called the median plane, and in this plane various ordinates are measured which run upwards towards the surface of the cerebral portion, or downwards to points of the facial portion of the skull. Upon both the terminal points of the base

* This is scarcely a fair criticism of Professor Busk's method, which chiefly errs on account of its diffuseness and prolixity. The author does not seem to be acquainted with the tables circulated by Messrs. Quekett and Busk many years ago; or with Mr. Busk's paper on "A Systematic Mode of Craniometry," in *Transactions of Ethnological Society*, vol. 1, new series, p. 341.—EDITOR.

line, the absolute measure of which is in comparison always assumed as unity, two perpendicular ordinates are erected, and the space between both extreme points equally divided by two other ordinates. Other perpendiculars are then drawn through the most prominent points of the frontal and occipital bones, and also through the posterior border of the foramen magnum, so that we have upon the base line, at various distances, seven perpendiculars, by which the contour of the curve, described by the median plane on the surface of the skull, can be determined with sufficient exactness to be used for graphic delineation. Less attention is paid by Aeby to the facial portion; it is determined by three lines which are drawn to the points of the nasal bones, to the upper jaw above the roots of the incisors, and to the posterior border of the bony palate. The development of the skull in breadth and height is represented by three transverse sections perpendicular to the base line. The hindmost of these is placed at equal distances between the external auditory opening and the articulation of the jaw; the central one at the point of greatest constriction behind the orbits, while the anterior one joins the zygomatic processes of the frontal bone, where they join the frontal processes of the zygoma. All these planes are measured by equidistant ordinates, like the median plane. All measurements being reduced to the base line as unity, Aeby obtains comparable numbers; and by multiplying the measurements he eliminates individual deviations, and reducing them to an average, obtains for each race, for each species, a definite mean number, and also comparable reduced normal skulls, capable of being arranged in series.

Aeby gives the following *resumé* of his measurements and calculations in the *Transactions of the Basle Society of Naturalists*:—"I expected to obtain from the median plane in particular, definite starting-points for the scientific division of human races; I was therefore not a little surprised to find just the contrary. If a close examination of more than five hundred skulls from all parts of the earth entitles one to express an opinion, then I must say, most decidedly, that the normal skulls of all races essentially agree with one another as

regards the median plane, and that in this respect the extremest dolichocephaly and brachycephaly show no difference whatever. The variations to which the occiput is subject are in some cases so abnormal and so great, even within individual limits, that they cannot be regarded as influencing the general law. Opposed to this constancy of the median plane, the differences in the frontal planes are the more striking. Here the cranial forms decidedly separate into narrow and broad. Each is distributed into particular regions; the former belonging to the southern, the latter to the northern, hemisphere. Africa and Polynesia, with New Holland, offer the narrowest, Europe, with Northern Asia, the broadest, forms of skulls. Southern Asia is intermediate between both divisions, not merely because its inhabitants (Chinese and Javanese, for instance) possess generally a medium breadth of skull; but also especially because some districts repeat the type of the most decided narrow skulls (*e. g.* Hindu), others, that of the broad skulls (some islands in the vicinity of Java). It is remarkable that the Greenlanders, though a high northern people, possess the most decidedly narrow skulls which exist. How it is in the rest of America I am unable to say, as I had not sufficient materials at my disposal. Both types seem represented. Some, at least, of the Brazilian peoples are narrow-headed; whilst the Botocudos and the Indians of the North are more or less decidedly broad-headed. The measurements, as already stated, all refer to the reduced skull, and are, therefore, independent of absolute size. I have not succeeded in finding a definite law of development for the latter.

"All differences, therefore, of the human cranial form depend essentially on the difference in the development of breadth. Platycephaly stands opposed to leptocephaly, though connected with it by gradual transitions. The uniform development of the median plane in the whole human species, appears to me a fact of the greatest interest. Not less important seems to me the observation that ethnic differences do not much obtain in childhood; for between the infantile skulls of Negroes and Europeans I find the greatest accordance. Median planes and frontal planes cover each other completely; an important fact

in the estimation of narrow and broad skulls: both originate from the same point, but in such a manner that whilst the growth of the latter proceeds at a uniform rate in all directions, that of the former is confined to transverse expansion. In this we find an accord with the type of development of the lower creatures. I have already elsewhere drawn attention to the similarity of all fœtal cranial forms. I am now prepared to lay it down as a general law, that a cranial form occupies a higher rank accordingly as it advances by uniform peripheral development from the fœtal form; and that it stands lower, accordingly as the growth is confined to certain directions and points. From this point of view, the narrow skull must be considered as a lower type. Of course, no inference must be drawn from this as to the mental capacity of the possessor of such a skull. We will not leave unmentioned that possibly the same position may be assigned to the most decided broad skulls. Some of these, at least (*e. g.* the Tunguse), have a tendency to vertical flattening. But if this be considered as arising from the predominance of the growth in width, we have the reverse of the type of development of the narrow skull. The most perfect form would accordingly be the intermediate one; and it is, perhaps, not without significance that this form is the inheritance of those peoples who have accomplished most in the province of intellect."

I must freely confess that I do not perfectly understand one point in this deduction. If "the uniform development of the median plane" means that the area of the vertical section is, in proportion to the base line, the same in all normal skulls, the result would be of considerable importance, and might be expressed in other words,—that the diminution of the frontal part, for instance, is compensated by the occipital part, and *vice versâ*. It appears to me, however, that the estimation of the median plane, from the few ordinates measured, must present considerable difficulties. But if the meaning is, that the individual ordinates, calculated upon the base line, are equal to each other, then I must express my disbelief, and should regard it as a fundamental defect in the whole system of mea-

surement, that it cannot show such differences as are found in the development of the forehead and the vertex.

If we return from this digression to the investigation of the normal base line, upon which measurement must depend, we find the same difficulties in determining a universal horizontal plane, as in determining the normal vertical one. In perfect repose the head is balanced upon the topmost vertebra, the so-called atlas, but as is easily seen, this equilibrium is disturbed both in the living subject and in the dead skull, in the most various ways. If, however, the above position is assumed as the normal, then selecting as the starting-point the aperture of the ear, the horizontal line passes nearly through the centre of the nasal aperture, a little above the point of the nose, in the living man. A horizontal line must, therefore, be assumed (its importance will be seen in the sequel), which can be determined by its terminal points, though it causes the head to deviate slightly from the natural position.

The half-dozen anthropologists who met at Göttingen, in the autumn of 1861, had a lively discussion with regard to the line, or rather the plane, which ought to be assumed as the horizontal. One proposed the zygomatic arch; another, a plane passing across the occipital foramen; a third, a line from the auditory aperture to the base of the nasal aperture. The zygomatic arch is never quite straight; the direction of the horizontal line passing through it must frequently be taken more according to the feeling than actual measurement. Even if we could succeed in laying a plane exactly across the occipital foramen—a task of considerable difficulty on account of its form—it cannot be determined in the living head, and as this plane is so short, every error would be magnified by the necessary prolongation of it. The only horizontal plane which can be termed rational is that between the two aural apertures and the bottom of the nasal apertures, and which may be determined both on the living head and on the skull. The horizontal line drawn in this way, between two fixed points, easily determinable both on the living head and dead skull, has moreover the advantage of representing one of the lines of Camper's facial angle, which has been long in use, and although defec-

tive in many respects, does not at all deserve the neglect with which it has been treated in some recent works. As regards the estimation of this angle, as well as of some others which can only be taken on the dry skull, it will be necessary to make some further observations.

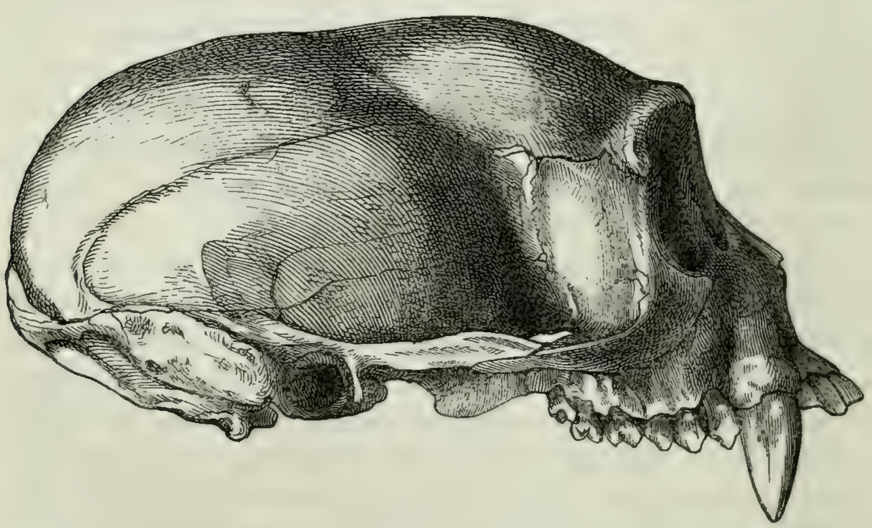
Fig. 1. Cranium of an Australian in profile, after Lucae.

The osseous framework of the head is composed of two intimately connected parts: the *cranium* proper, containing the brain, and forming a firmly closed box with a few apertures only, through which the spinal cord, nerves, and blood-vessels obtain access to the brain; and *the face*, containing spaces for the more important organs of sense and the entrances to the respiratory and digestive organs. On comparing the formation of the head in man and brute, we see, at the first glance, that in the former the skull-cap, and consequently the enclosed brain, predominates considerably over the face, which appears like an appendage to the skull. For we must bear in mind, that in normal skulls a plane drawn from the upper margin of the eyebrows through the aural apertures, passes to the posterior edge of the *occipital foramen;* that is to say, almost entirely within the internal cranial space, and that when the head is thus divided into two parts, the upper portion con-

tains the brain, the lower the face. If the dried skull is looked at without the lower jaw, the disproportion is still more striking. The forehead, which, according to artistic notions, constitutes so essential a part of the countenance, belongs to the skull, and not to the face; it is, in fact, one of the most important parts of the cerebral cranium, and must be particularly attended to in investigating the peculiarities of the structure of man.

Let us now compare the formation of the human head with that of any other animal, and we shall find two essential differences depending on the proportions of the two parts. The cranium proper is in man absolutely larger than in the brute, in which the face frequently occupies more space than the brain-case; in man, too, the face is, to a certain extent, a sort of appendage, fastened on under the cranium, whilst in the animal the cranial cavity lies rather behind the face. In man the roof of the orbits, upon which the anterior lobes of the brain rest, forms nearly a horizontal plane; in the animal it may be nearly vertical. In man a perpendicular line drawn from the root of the nose falls usually upon the canine tooth; in the animal upon the posterior molars.

Fig. 2. Skull of the Weeper Monkey, *Cebus apella,* in profile.



In man the forehead is arched forward; in the animal, on the

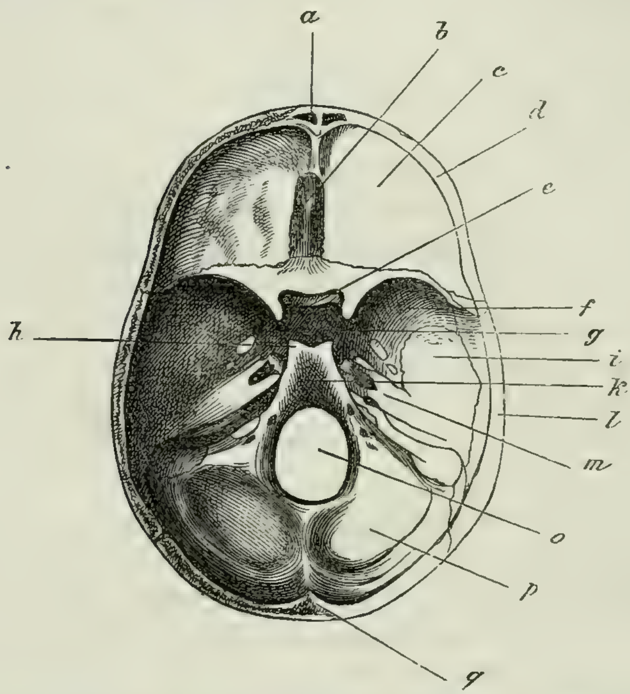
contrary, the face projects in a muzzle, whilst the forehead and the cranium recede. Camper endeavoured to express this relation by his facial angle. The more the muzzle projects and the forehead recedes, the more acute must be the angle formed by two lines, one of which is drawn from the aural aperture to the margin of the upper jaw, and the other from the jaw to the most prominent point of the forehead. It is true, Gentlemen, that the facial angle does not altogether answer its purpose; it is true that Camper did not definitely determine it, so that some take the angle at the nasal spine, others at the alveolar margin. It is also true that there are skulls in which the projecting snouts depend almost entirely upon the formation of the jaws. In many cases, too, the eyebrows are very prominent, such prominence depending not upon the development of the brain, but upon that of the frontal sinuses, which are connected with the nose. But, granting all these objections, it must be admitted that similar ones may be made to most other measurements, and that conclusions as to the general proportions of a skull cannot be deduced from a single measurement. Camper's angle alone cannot afford a valid standard of the relative proportions of skull and face, still it fairly represents these proportions, and should in no case be neglected.

It must not be forgotten that all these observations, which have for their object the determination, not merely of the external form of the head, but of the proportions of its parts, have to be made chiefly on the dead skull, and not on the living head. The real proportions can only be ascertained when the skull is bisected, so that both the right and left halves may be inspected and measured internally and externally. As I cannot expect you to be acquainted with anatomical details, I venture to offer a few explanations, which I shall endeavour to make as short as possible.

The basis of the cranium, upon which the brain rests, consists essentially of four bones: the occipital, the sphenoid, the ethmoid, and the frontal. By the aperture in the occipital the spinal cord reaches the brain; the optic nerve passes through the sphenoid to the eye, and the olfactory through the ethmoid bone. We need not notice the frontal

bone, as it merely assists in supporting the anterior lobes and can scarcely be considered as belonging to the base of the

Fig. 3. Base of skull, inner surface; calvarium removed.

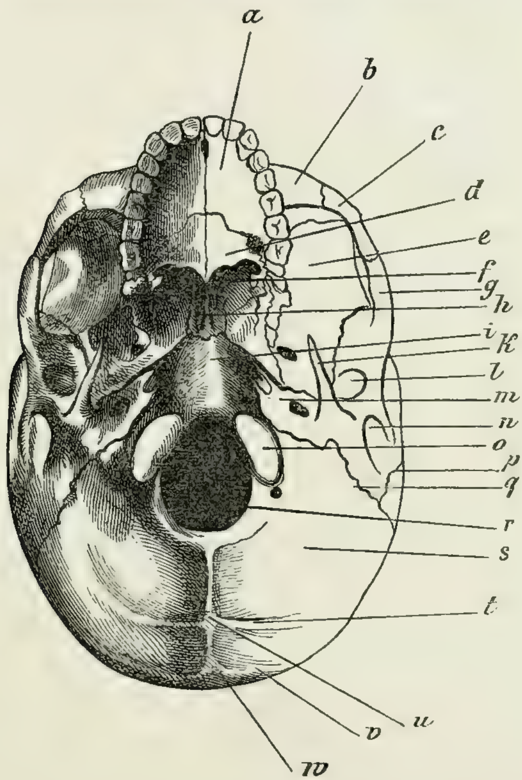


a. The frontal sinuses connected with the nasal cavity. *b*. The ethmoid bone, with the crista galli and cribriform plate for the passage of the olfactory nerves. *c*. Anterior fossa, roof of the orbit. *d*. Frontal bone. *e*. Anterior clinoid process. *f*. Great wing of the sphenoid bone. *g*. Body of the sphenoid bone; depression of the sella turcica. *h*. Posterior clinoid process. *i*. Squama of the temporal bone. *k*. Body of the occipital bone. *l*. Parietal bone. *m*. Petrous portion of the temporal. *o*. Occipital foramen. *p*. Cerebellar fossa. *q*. Occipital squama.

brain. The central parts, or bodies, of the occipital, sphenoid, and ethmoid bones, correspond to vertebræ, which, however, are considerably modified in their structure. The ethmoid bone exhibits, though imperfectly, the form of a vertebra without peripheral parts; the occipital bone, on the contrary, represents a perfect vertebra, having not merely articulating surfaces for the succeeding vertebra, the so-called atlas, but forming the *foramen magnum*, by which the continuation of the spinal cord enters the cranium. The sphenoid bone finally represents an intermediate shape, its body, on the one hand, being a continuation of

the occipital bone, and the wings, on the other hand, which assist in closing the orbits and the temporal fossæ, forming side pieces, and at least tending towards the formation of an arch.

Fig. 4. Base of skull viewed externally.



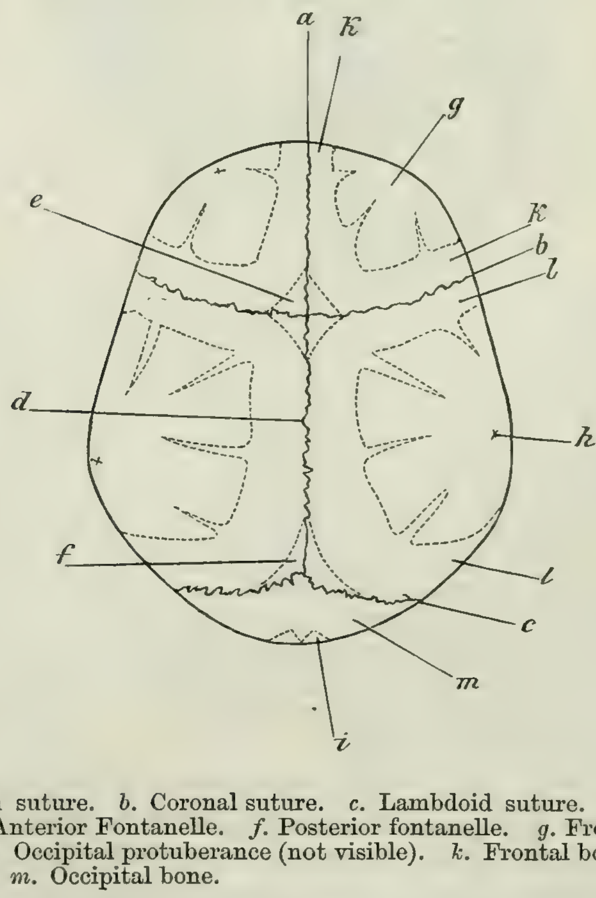
a. The palatine process of the superior maxillary forms with *d*. the horizontal plate of the palate bone, the bony palate. *b*. Zygomatic process of the superior maxillary forms with *c*. the zygoma, and *g*. the zygomatic process of the temporal bone, the zygomatic arch. *e*. Temporal fossa, formed chiefly by the greater wing of the sphenoid. *f*. Posterior nasal spine. *h*. Vomer. *i*. Body of the basilar bone, formed of the confluent bodies of the sphenoid bone (in front) and the occipital bone. *k*. Styloid process of the temporal bone. *l*. Glenoid fossa for the condyle of the lower jaw. *m*. Pyramid of the petrous portion. *n*. Mastoid process of the temporal bone. *o*. Articular surfaces of the occipital bone. *p*. Posterior inferior angle of parietal bone. *q*. Lambdoid suture. *r*. Foramen magnum. *s*. Squama of the occipital bone. *t*. Inferior curved line. *u*. Occipital crest. *v*. Superior curved line. *w*. Occipital protuberances.

The vault of the cranium is completed by the arched bones termed the temporal, parietal, and frontal, which are joined together by sutures. It is important to know the course of these sutures. On looking at the skull from above, there is seen on the vertex a transverse suture which separates the frontal from

the two parietal bones—*the sutura coronalis.** The two parietal bones are separated by a longitudinal suture (*the sutura sagittalis*).† In the earliest stages of existence this suture is continued to the root of the nose and thus divides the frontal bone into two symmetrical halves, but in normal skulls the aperture is closed before birth; in some broad heads the frontal suture remains during life. The sagittal suture terminates in the occiput, where it touches a triangular suture which separates the occipital from the parietal bones, and is called the lambdoid suture.

The cranial bones are developed at the expense of a cartila-

Fig. 5. Outline of an adult skull with persistent frontal suture, top view, after Welcker. The positions of the two fontanelles are marked by dotted lines, as well as the outlines of the bones as they are developed in the newborn child.



a. Frontal suture. *b.* Coronal suture. *c.* Lambdoid suture. *d.* Sagittal suture. *e.* Anterior Fontanelle. *f.* Posterior fontanelle. *g.* Frontal protuberances. *i.* Occipital protuberance (not visible). *k.* Frontal bone. *l.* Parietal bone. *m.* Occipital bone.

* "Fronto-parietal" suture.—Editor. † "Interparietal" suture.—Editor.

ginous or membranous base from separate osseous points, some of which are symmetrically placed on both sides of the median line, others lie in the central line. Increasing in growth—the laws of which Welcker has recently established,—the bones approach each other and are finally connected by sutures.

Thus it is well known that in new-born children the sutures are not closed on the top of the head: the openings are the so-called fontanelles. The anterior or the large fontanelle is of an oblong shape, and corresponds to the junction of the sagittal and coronal sutures, the posterior, triangular in shape, is situated at the junction of the sagittal and lambdoid sutures. These fontanelles usually close in the course of the first year. The frontal suture closes sooner. Synostosis of the sphenoid and occipital bone frequently takes place at maturity, so that some anatomists* have described them as one bone. All these sutures are often closed in old age. Premature closing is frequently the cause of the arrest of cerebral development. The order in which the sutures close appears to be connected with the development of individuals and races, as we shall see in the sequel.

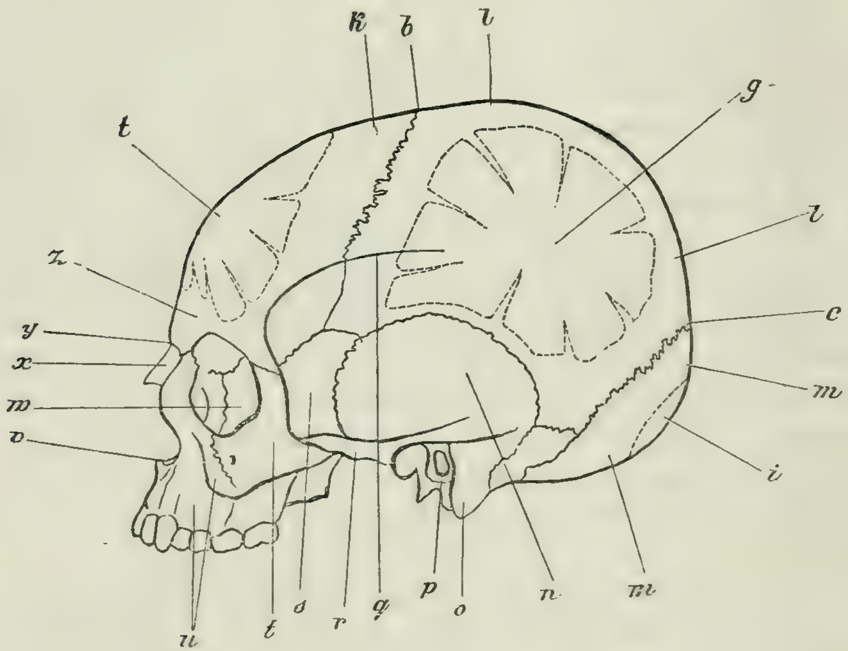
Some of the osseous points from which the cranial bones are developed may be observed as prominences in the adult skull. This is not, however, always the case; in some crania they are obliterated, in others very perceptible. Such are the frontal eminences (tubera frontalia) above the eyebrows, the parietal protuberances (tubera parietalia), and the occipital prominence (tuber occipitale) in the centre of the squama occipitis. These prominences are very distinct in the infant, and if, as is done in the annexed figures, the outlines of the embryonal bones are marked on the adult skull, and the corresponding prominences superposed, we obtain a good idea of the growth of the respective bones from birth to adult age.

The base of the head formed by the three cranial vertebræ is of great importance, as it determines the development of the cranium, as well as that of the face; the cranium, as regards development and interpretation, being only a radiation of the parietal parts of the base, and the face being appended to them,

* Meckel especially.—EDITOR.

every change in the development and juncture of these three fundamental bones must necessarily influence both parts of the

Fig. 6. Side view of the skull, as in preceding figure. *a.* to *m.* have the same signification.

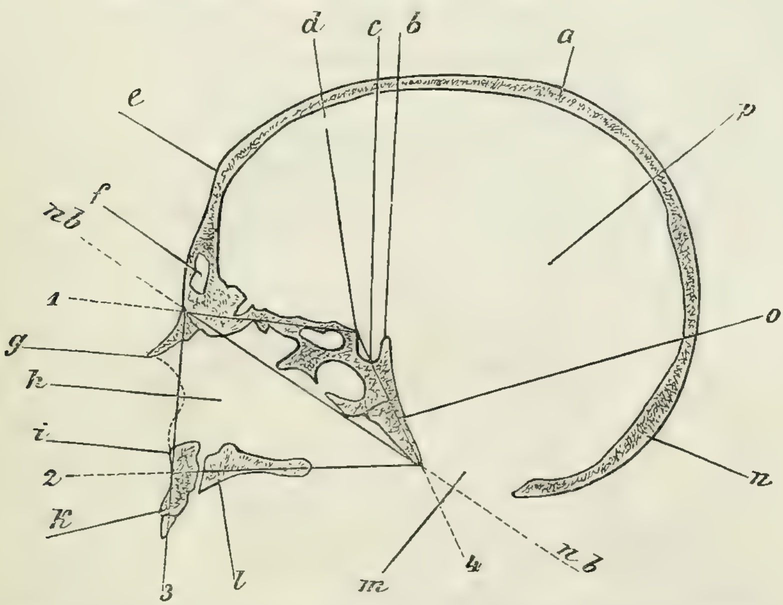


n. Squama of temporal bone. *o.* Mastoid process. *p.* External auditory aperture. *q.* Temporal ridge. *r.* Zygomatic arch. *s.* Wing of the sphenoid bone. *t.* Zygoma (cheek bones). *u.* Upper jaw. *v.* Nasal spine. *w.* Orbit. *x.* Nasal bone. *y.* Nasal suture. *z.* Glabella.

head, inasmuch as these in a certain degree represent the two arms of a lever which finds its central point in these bones. On inspecting a skull sawn through, so as to divide these bones longitudinally through the centre, we perceive that they do not, at all events, in normal skulls, present a straight line, but an angular surface, the centre of which is in a depression of the sphenoid bone called the "Turkish saddle" (sella turcica). Upon this "saddle" rests an appendage of the brain situated almost in the centre of the lower surface of the cerebral mass. In the same spot where the angle is formed, that peculiar cartilaginous body the chorda, terminates what served as the central point for the formation of the vertebræ of the embryo at the earliest period. It has been observed that

in all higher vertebrate embryos, there is at this spot a considerable curvature of the cerebral axis, by which, at a time when scarcely the first foundation of the face exists, the anterior part of the head is bent like the anterior phalanx of a finger when we close the fist. Though this original curvature in the embryo is subsequently diminished both by the growth of the face and the brain, there still remains, even in mature age, a trace of this formation so characteristic of the higher vertebrates. The region in the vicinity of the sella turcica, and the bones connected therewith, are, then, in many respects the apex of the angle, the central point on which the skull and face turn, and of the greatest importance in the study of them. To Professor Virchow belongs the merit of having

Fig. 7. Vertical section in the median plane of the skull of a very orthognathous German, after Welcker.



a. Parietal bone. *b.* Cantle of saddle. *c.* Turkish saddle (sella turcica). *d.* Pommel of saddle (olivary process). *e.* Frontal protuberances. *f.* Frontal sinus. *g.* Nasal bone. *h.* Nasal cavity. *i.* Anterior nasal spine. *k.* Dental margin of the superior maxillary. *l.* Osseous palate. *m.* Foramen magnum. *n.* Occipital squama. *o.* Body of occipital bone. *p.* Cerebral cavity.

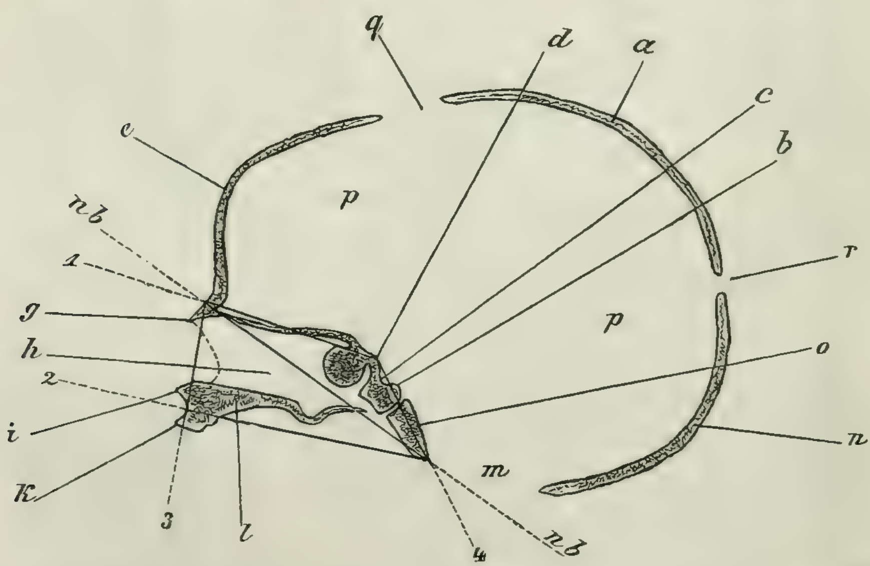
The lines continued beyond the skull by dots are measuring-lines, which are explained in the Table, and indicate at the same time the angles of the facial quadrangle, they enclose—1. Fronto-nasal angle and line *n e*. 2. Dental angle and line *b x*. 3. Line *n x*. 4. Line *b e* and foraminal angle. Line *n b* and *n b* = length of the cranial vertebræ, according to Virchow. See Table No. 6.

first pointed out the importance of the relations of these bones to cerebral and cranial development, and of having shown that the size and position of the so-called sphenoid angle are absolutely requisite for examining the skull and face—a truth which has been very recently confirmed by Welcker's numerous measurements.

In fact, Welcker has shown that the more the sphenoid bone is bent, that is to say, the smaller the sphenoid angle, the more perpendicular is the position of the teeth, and that the sphenoid angle becomes larger in proportion to the greater obliquity of the incisors produced by the enlargement of the facial bones. Besides this, Welcker has proved that the measurement of this angle, which is determined by three points, namely, the root of the nose at the juncture of the nasal and frontal bone, the anterior margin of the occipital foramen, and the "pommel of the saddle" (olivary process); he has proved, I say, that this angle and its development in man is an excellent corrective of Camper's facial angle, as well as a distinctive character between man and ape. I will explain the matter further.

In the infant, the head and cranium are proportionately very

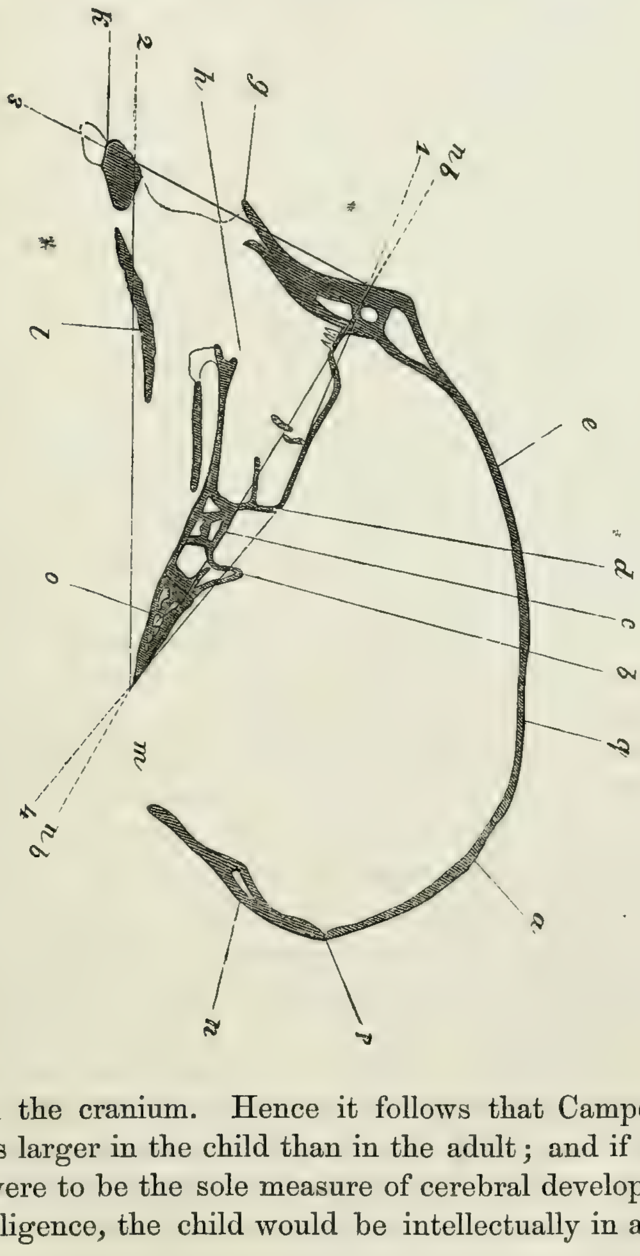
Fig. 8. Vertical section of the skull of a new-born child, after Welcker.



Description the same as in the preceding figure, except, in addition, q, anterior fontanelle, r posterior fontanelle.

large, the forehead is arched, the brain more developed, so to speak, than any other part of the body; the jaws especially are remarkably slightly developed, the teeth are absent. During the first year, the growth is accordingly greater in the face

Fig. 9. Vertical section of the skull of *Cebus apella*, natural size. Description the same as in the two preceding figures.



than in the cranium. Hence it follows that Camper's facial angle is larger in the child than in the adult; and if the facial angle were to be the sole measure of cerebral development and of intelligence, the child would be intellectually in advance of

the adult. But it is different with the angle of the sella, which is more obtuse in the child than in the adult, so that in this respect the correct proportion is established. But according to Welcker's researches, there is a great difference as regards the formation of this angle between man and even the ape nearest allied to him. It is well known—and we shall subsequently revert to this point—that in the most anthropoid apes, the chimpanzee, gorilla, and orang, the young animal in every respect resembles man more than the adult, and that this relapse to the semblance of the brute, consists essentially in the fact that the cranium remains stationary as regards cerebral capacity; whilst the jaws and the whole face are greatly developed, and project in the form of a muzzle. In correspondence with this, we find that, *e.g.*, in the orang the angle of the sella is the more obtuse the older the animal is; whilst, on the contrary, in man this angle is smaller in the adult than in the child. "If," says Welcker, "the skulls are arranged according to Camper's angle, the skull of the infant, contrasted with that of any animal, occupies a higher place than the skull of the adult; but if the skulls are arranged according to the increasing size of the angle of the sella the series stands: man, woman, child, animal."

If a fourth point be added to the three which mark the angle of the sella, namely the nasal spine, and if these points are connected by lines, we obtain an irregular quadrangle, which pretty nearly circumscribes the whole face, exclusive of the lower jaw, and the form of which depends on the development of the bones and their curvatures. The four corners of this quadrangle might be termed the sella-angle, the nasal-angle, the dental-angle, and the foraminal-angle; and we may, by comparing these angles in different individuals and races, discover important and constant proportions in direct relation to the development of the face and the base of the skull. A diagonal of the facial quadrangle, drawn from the anterior margin of the occipital foramen to the root of the nose, and of which the length can be easily estimated in either opened or unopened skulls, is so far important, that it corresponds

with the axis of the curved cranial base, and thus, by its relative length or shortness, indicates the curvature of this axis.

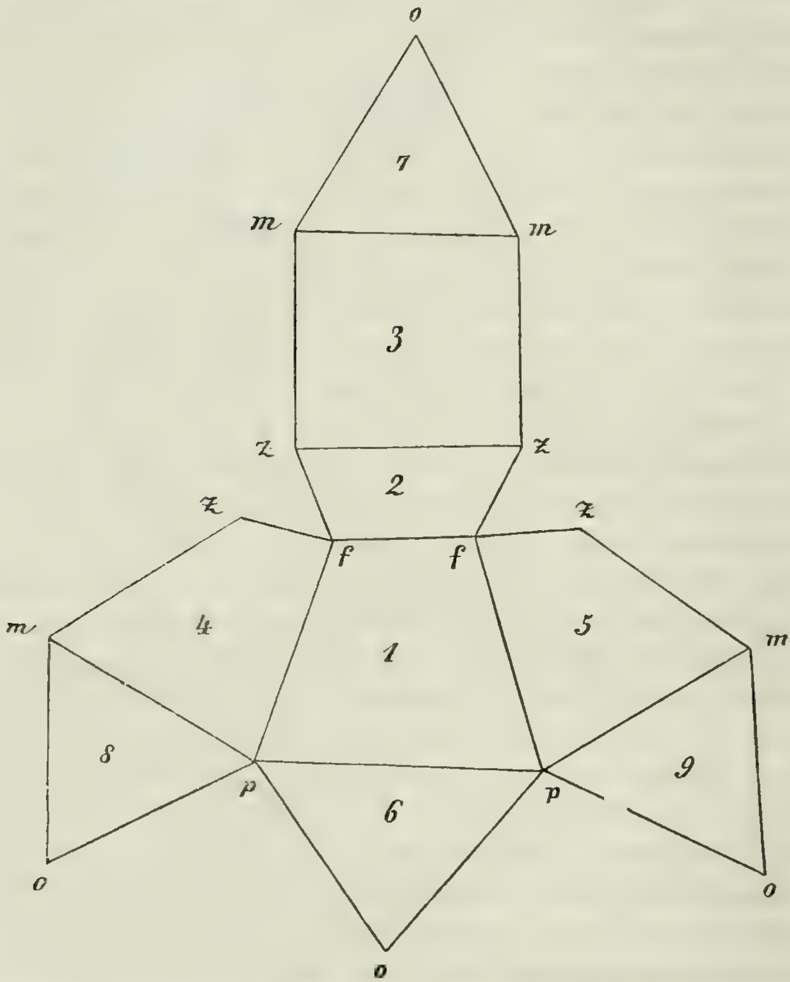
Whilst by means of the facial quadrangle, and a few transverse diameters, the face can easily be characterised in its chief features, the difficulty is much greater as regards the cranium proper. This hollow case presents so many deviations from the oval form, the various points on which the measurement is based are so easily misplaced, that it is extraordinarily difficult to establish a system of diameters, radii, and angles universally applicable to all crania. Huschke, in a big book containing much that is valuable as well as much that is singular, has not only proposed, but carried out on several specimens, a formal triangulation of the skull, by means of which he endeavours to calculate the area of the cranial bones and their relative development. His object was to find the superficial extent of the three cranial vertebræ, which, in accordance with a natural-philosophical idea which Carus has specially defended, bears a special relation to the intellectual functions. No one has hitherto followed this path, and we doubt whether any one will pursue the same method by reason of the irregularity of the cranial bones, and the numerous sources of error incidental to the system, nor does the development of the individual cranial vertebræ stand in constant proportion to that of the brain and its lobes.

Welcker has selected for the designation of the measurements of the skull a geometrical construction, which he terms the cranial net, resembling the reticulated designs used in making paper and pasteboard figures of crystals.

Though a figure composed of triangles and squares cannot give a correct representation of the skull and face, the cranial nets still exhibit such characteristic forms and peculiarities, that they afford us considerable assistance in determining cranial measurements.

At the meeting of anthropologists in Göttingen, Von Baer justly observed, that however many measurements are tabulated, they cannot stand in the place of general impressions made by the skull itself examined from various points of view, and that it would be well to agree upon the designation of definite characteristic forms, as is done in botany with regard

Fig. 10. Cranial net, after Welcker. The measures are taken from an asymmetrical skull. The lines of which the diagram is composed have the same names as in the table at the conclusion of the lecture.



f. Frontal protuberances. *p*. parietal protuberances. *z*. Zygomatic process of frontal bone. *m*. Mastoid process. *o*. Occipital protuberances. 1. Superior cranial quadrangle. 2. Frontal quadrangle. 3. Basal quadrangle. 4 and 5. Lateral trapezia. 6. Superior, 7, inferior, 8 and 9, lateral, occipital triangles.

to the shapes of leaves and flowers. Welcker also admits that many important peculiarities of parts situated between the points of measurement, can only be determined by a very complicated process, *e. g.*, the shape of the frontal profile, the degree of elevation of the various eminences, the circumference of the skull, &c.; and that, for all these particulars, pictorial representations and full and lucid descriptions must supplement the measurements.

According to Von Baer the following characteristic relations with regard to form, may be pointed out in the aspect of skulls from different points of view:

THE VERTICAL VIEW (*norma verticalis*) was designated by the venerable Blumenbach as highly important and characteristic, although, strange to say, there is not a single figure of this kind to be found in his decades of views of the cranium. "Very frequently," says Von Baer, "the form of the cranium viewed from above, is oval, if the transition from the frontal bone to the zygoma is kept out of view. The shape is sometimes very like that of a common hen's egg, that is, simply oval, sometimes broadly oval, sometimes longer, narrowly oval. In the broad form the rounded part in front is frequently wanting, the forehead is not arched transversely, but is broad and flat; in others, especially the short-heads, this form occurs in the occiput; there are anteriorily and posteriorily shortened oval shapes; and if forehead and occiput are equally flattened, and the sides slightly compressed, there results the form which has been termed quadrate." But sometimes, especially among the long-heads, the occipital region is found as pointedly arched as the forehead, so that no true broad end exists, a form which Baer designates not quite correctly as elongated oval. And, finally, there are forms very closely resembling the elliptical, though the largest transverse diameter is always a little behind the centre.

But this vertical view is of special importance, as exhibiting, at a glance, the proportion of the longitudinal to the transverse diameter of the cranium. This proportion is, in fact, so important, that recent French authors* term it the cephalic index (*indice céphalique*), and designate it by a single cipher, which is obtained by assuming the longitudinal diameter = 100, and reducing the transverse diameter to this denomination; cephalic index = 80, means, therefore, that assuming the longitudinal diameter to be 100, the transverse is 80. As Welcker observes, Blumenbach designated the Negro and the Calmuck skull as the extremes of cranial form, and he added, that a model, made of wax (better, now-a-days,

* Especially Broca.—EDITOR.

of gutta-percha) of the Caucasian, would, by lateral pressure, assume a Negroid shape, whilst, by antero-posterior pressure, it would assume a shape like that of the Calmuck.

Fig. 11. Top view of the skull of an Australian, after Lucae. Dolichocephalic, elongated oviform shape.

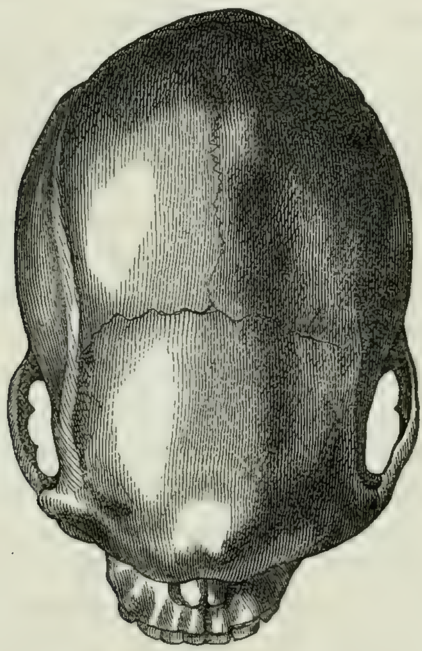
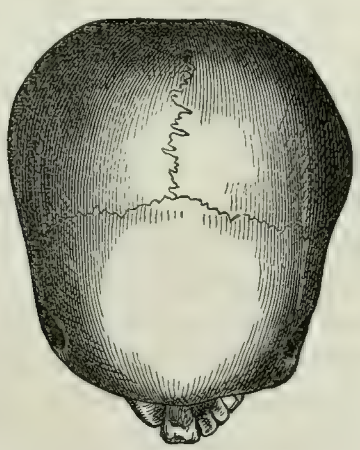


Fig. 12. Top view of the skull of a Little-Russian, after Von Baer. Remarkably brachycephalic, quadrate form of skull.



Retzius made use of this character, and founded upon it his division of peoples into long-heads (dolichocephali), and short-heads (brachycephali). This division was first founded upon an examination of Swedish and Sclavonian skulls, and, in these cases, Retzius gave the proportion of the two diameters as follows: in Swedes, the greatest length to the greatest breadth, as 1000:773, that is nearly as 9:7; in Sclavonians, as 1000:888, or nearly as 8:7. It must, however, be admitted that Retzius' measurements were confined to a few skulls, which he selected as typical, and that he estimated the cranial shape rather from the general impression of the aspect of skulls than by exact measurements. It must also be kept in view, that though Retzius only applied these various forms to distinguish different tribes, *e. g.*, Swedes and Sclavonians, Finns and Lapps, he expressly says that both these cranial forms are to be found in every one of the assumed chief races.

Welcker has more closely examined this question, and proved, by numerous measurements, that long- and short-heads represent the extreme forms, but that between these there are many nations presenting gradual transitions, so that a third group must be interposed, which might be called orthocephali.* Welcker has measured, as far as he could, a considerable series of skulls, with the interesting result, that the different stocks diverge constantly, and within somewhat wide limits, from one common centre, but that the variations are of nearly equal extent on both sides, and appear to be greater in proportion to the commixture of the race. Thus, the variation among Lapps, Cossacks, ancient Greeks and Romans, Hindus, Esquimaux and Australians, are but very slight; much greater among Italians, Germans, Russians, and Finns; and greatest among the Buggese and French, on whose cranial forms the Frankish invaders had a considerable influence. Broca's measurements of skulls, taken from old and recent Parisian cemeteries, yielded similar results. The unquestionable intermixture of the inhabitants of Paris, from

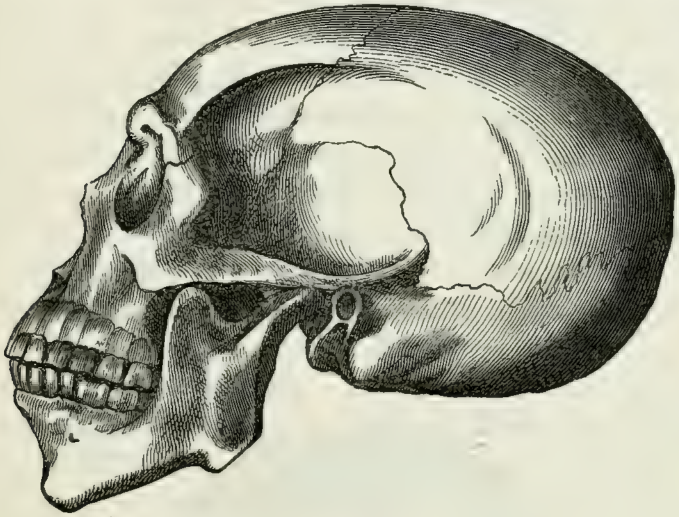
* This remark has been made by Broca before Welcker; Broca proposed a better name, "middle-heads" (mesaticephali), which we shall use in preference.

the earliest origin of that city, is easily detected in the series of skulls, including long-, short-, and middle-heads, the oldest of which date from the time of the Carlovingians. The extension of the series may, in future measurements, afford a standard for the degree of intermixture, and the confinement of variation in size within narrow limits be regarded as a proof of the purity of a stock. Taking the tables of Welcker as a basis, and assuming the longitudinal diameter of the skull = 100, the following results are obtained for the various races: where the mean of the transverse diameter is below 72, they may be termed long-heads; where it exceeds 81, short-heads; where it varies between 74 and 81, middle-heads. Setting aside the old Peruvians, among whom the heads of children were artificially deformed, to such an extent that the transversal diameter sometimes exceeded the longitudinal, the series of decided *brachycephali* includes the Lapps, Macassars, Madurese, Bashkirs, Turks, and New-Italians; among the *dolichocephali*, are comprehended the Nukahivans, Hindus, Esquimaux, Negroes, Australians, Kaffirs, Bushmen, and Hottentots, who reach the highest standard of dolichocephaly, so that one of the skulls measured exhibits the simian proportion of 63 for the transverse diameter. The series of *mesaticephali* may be arranged as follows, those with the shortest heads first, and those with the longest heads last: Germans, Russians, Buggese, Sumatrans, Calmucks, Javanese, French, Cossacks, Jews, Gipsies, Moluccans, Indians, Chinese, Finns, ancient Greeks, ancient Romans, Brazilians, Dutch. One might almost be led to conclude from this table that the most favourable conditions for civilisation are to be found in the intermediate position between the two extremes, a conclusion which would be flattering to the French, as they form nearly the centre of the mesaticephali, just as they consider themselves as the centre of civilisation. But we shall see in the sequel that there are other conditions which exercise a definite influence.

The LATERAL VIEW or profile best exhibits a proportion which may also be observed from above, namely, the relation of the cranium to the face, and especially the projection or retrocession of the jaws. We have seen that the projection of

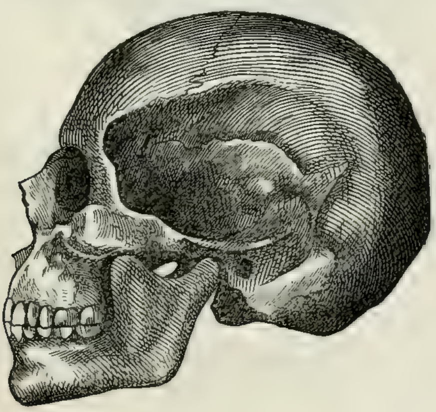
the face impresses an animal character upon the physiognomy, a circumstance which has long since been taken into consideration in craniology.

Fig. 13. The skull of a Negro in profile as a type of prognathism.



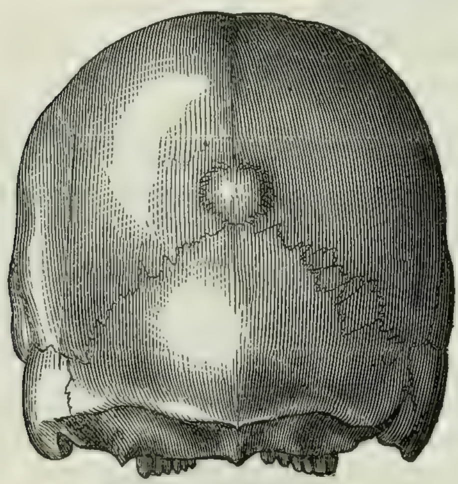
On looking at a characteristic Hottentot or Negro skull in profile, the face projects like a muzzle, and the incisors are obliquely inserted, so that their edges meet as at projecting angles. On viewing a German skull, on the contrary, we see that the incisors meet perpendicularly; and that on closing the

Fig. 14. The skull of a Tatar in profile, after Von Baer. Orthognathous, and at the same time a mesaticephalic head of round shape.



mouth the lower incisors are a little behind the superior, whilst in the Negro they are rather in advance. This formation, the orthognathous, has been accordingly distinguished from the prognathous, and it has been observed generally that this development of the jaws is in direct relation to the intellectual capacity of a people, the prognathous being confined to the lowest races of man. Welcker has subjected this difference to measurement by taking the angle formed *at the root of the nose* by the central line of the base of the skull or the diagonal of the facial quadrangle, and the line drawn from the root of the nose to the nasal spine as the measure of the position of the jaws.

Fig. 15. Ancient Helvetian skull, viewed from behind.*



According to him, the following peoples are prognathous, all the rest being orthognathous: Kaffirs, Australians, Negroes, Bashkirs, Hindus, New Hollanders, Hollanders, Brazilians, Cossacks, and Sumatrans. I must also add that

* This skull, which was discovered with Roman antiquities near Geneva, belongs undoubtedly to the Helvetian type.

Welcker distinguishes the extremely orthognathous as opisthognathous (or with retreating teeth), a distinction which does not seem to me quite justifiable.

Besides this position of the jaws which is connected with the curvature of the cranial basis, the length of which seems to increase in proportion to the projection of the jaw; the side view also gives us a general idea of the roundness of the skull, the arch of the forehead, the development of the occiput, the elevation of the vertex, and the proportion of the perpendicular to the longitudinal diameter. Just those points in which the human cranium differs most from that of the animal, as, for example, the projection of the brain and its anterior lobes over the face, in connexion with an arched and more or less perpendicular forehead, are best seen in a side view, and this view must, therefore, in no way be neglected.

The POSTERIOR VIEW (*Norma occipitalis*) and the ANTERIOR VIEW (*Norma frontalis*) supplement each other, and I cannot do better than quote the words of von Baer on this point: "If," says Baer, "we place a skull so that the assumed horizontal line corresponds with the visual axis of the observer and examine the skull at a distance from behind, it will sometimes be found that with a full development of the parietal eminences and a roof-shaped vertex, the outline assumes the shape of a pentagon. Although this pentagon never exhibits sharply defined angles, still the figure is often very plain, generally rather broad than high, and may be briefly described, according as the angles are rounded or sharp, the lateral planes straight, arched, shorter or longer. The rounding of the angles is, however, not unfrequently so great that, leaving out of notice the mastoid processes, which often recede, or are elevated so as to be scarcely perceptible, the outline is elliptical instead of pentagonal. The ellipsis is usually rather high than broad, rarely the reverse, and still more rarely is the difference between the perpendicular and the horizontal axis so slight, that the aspect may be termed circular. This outline is as variable as it is perceptible, so that we must not expect to find it always similar, even in

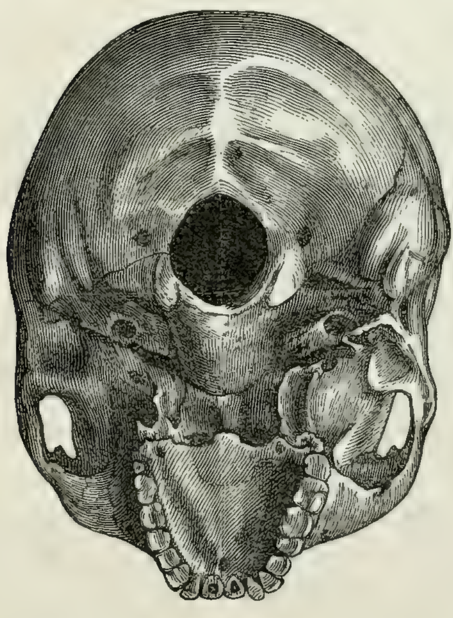
unmixed races. The general proportions, however, are the same, and, regard being had to the variations, they will be easily recognised."

The view from behind best gives the proportion between the height and the breadth of the skull, which is specially important in the estimation of the capacity of the cavity. Not less important is the flattening or roof-shaped form of the vertex, which is best seen from behind. There are heads which tower up, and terminate either in a platform or a pointed roof. We sometimes meet with children in whom skulls of this shape are evidently the result of some morbid process, which, however, does not seem to interfere with the health or intelligence of the individual. In some tribes such "*tower-heads*" (pyrgocephali), are characteristic, and to be regarded as the result of normal formation. There are, also, *pyramidal heads*, where the parietal planes meet in a point, whether the cranium be viewed from before, behind, or in profile. Prichard observed that such pyramidal heads are specially prevalent among the nomadic tribes of Asia and America; but he also included among them, as von Baer justly observes, those peoples in whom the parietal planes do not meet in a point, but in a long ridge, and which might, therefore, be called "*rafter-heads*" (tectocephali). It is true, a rafter-shaped head, such as possessed by the Esquimaux, for example, much resembles a pyramidal head when viewed in front or behind, because the ridge coincides with the line of sight; but a view of the side immediately shows the difference. Unfortunately, von Baer has chosen for this rafter-shaped skull the term cross-shaped, or rhomboidal, which does not appear to me suitable.

The anterior view of the skull best indicates the relation of the face to the anterior lobes of the brain, as well as the various diameters of the face. The development of the frontal eminences and of the ridges over the eyebrows, the form and position of the orbits, the shape of the nasal apertures, the prominence of the cheekbones—all these proportions appear to be of great importance for the estimation of ethnic peculiarities.

Fig. 16. Skull of an Australian, front view, after Lucae.

Fig. 17. Helvetian skull, viewed from below.



The examination of the skull FROM BELOW appears to be of great importance when we consider that the curvature of the basilar plane, and the position of the occipital foramen indicate the

greater or lesser animal resemblance of a skull. The position of the foramen magnum forward or backward, the distance of its anterior border from the posterior margin of the osseous palate and the alveolar margin of the lower jaw, the breadth and curvature of the zygomatic arch, the distance of the articular cavities of the lower jaw, the distance and curvature of the mastoid processes, the direction of the auditory openings, and the curvature of the petrous portion of the temporal, the height and breadth of the posterior nostrils—all these proportions deserve the fullest consideration. The very complicated structure of the base of the skull does not, however, admit of a definite terminology of the parts similar to that applied to the other views of the cranium. We shall have to recur to some points touched upon here in our next lecture.

TABLE OF MEASUREMENTS BY SCHERZER AND SCHWARZ.

I. GENERAL OBSERVATIONS.

Name, Sex, Native Country, Occupation, Shape and Growth of Beard, etc.

	No. of the Systematic Series.
1. Age of the individual measured - - - -	1
2. Colour of hair - - - - - - -	2
3. Colour of eyes - - - - - - -	3
4. Number of pulsations in a minute - - - -	4
5. Weight - - - - - - - -	5
6. Pressing power (force manuelle) measured with the dynamometer of Régnier - - - - - -	6
7. Lifting power (force rénale), ditto ditto - -	7
8. Total height - - - - - - - -	8

II. MEASUREMENTS WITH THE PLUMMET AND METER-SCALE.

9. Distance of the commencement of the growth of hair on the forehead from the perpendicular - - -	9
10. ,, of the root of the nose from the perpendicular -	10
11. ,, of the anterior nasal spine from the perpendicular	11
12. ,, of the point of the chin (mental process) from the perpendicular - - - - - -	12
13. ,, from the root of the nose to its tip - -	13
14. ,, from the tip of the nose to the anterior nasal spine	14

III. MEASUREMENTS WITH THE CALLIPERS.

		No. of the systematic series.
15.	Distance from the point of the chin to the commencement of growth of hair - - - - - - -	17
16.	„ from the point of the chin to the root of the nose	15
17.	„ from the point of the chin to the anterior nasal spine - - - - - - -	16
18.	Distance from the point of the chin to the vertex -	19
19.	„ from the point of the chin to the crown of the head	21
20.	„ from the point of the chin to the external occipital protuberance - - - - - - -	23
21.	„ from the point of the chin to the external auditory opening - - - - - -	25
22.	„ from the point of the chin to the angle of the lower jaw - - - - - - -	27
23.	From the root of the nose to the vertex - - -	20
24.	Distance from the root of the nose to the crown of the head	22
25.	„ from root of the nose to the external occipital protuberance - - - - - -	24
26.	„ from the nasal root to the external auditory opening - - - - - - -	26
27.	„ from the nasal root to the angle of the lower jaw	28
28.	„ from the place where the hair begins to grow to the *incisura jugularis sterni* - - - -	18
29.	„ from the external occipital protuberance to the seventh cervical vertebra—the measurements 28 and 29 must be taken with the head in the same position, *i. e.*, the natural one - - - - - -	56
30.	„ from one external auditory opening to the other	30
31.	„ of the uppermost points of attachment of the ear	31
32.	Greatest distance between the zygomata, or zygomatic arches* - - - - - - - -	32
33.	Distance between the external corners of the eyes -	33
34.	„ between the internal corners of the eyes -	34
35.	„ between the points of attachment of the lobes of the ear† - - - - - - -	35
36.	Breadth of the nose - - - - -	36

* The following measurements may then be made. From the point taken by the callipers on the zygoma to the commencement of the growth of the hair on the forehead, in the median line, and also to the point of the chin. By this the most prominent point of the cheek bone in the facial plane may be determined.

† Measure also the breadth of the forehead in the horizontal line :—

(*a*) From one part of the *linea semicircularis,* which may be felt like a *crista* beneath the skin, to the other. The spot where the convexity in front is greatest should be selected.

(*b*) In the same horizontal measure the greatest breadth of the forehead, from the beginning of the growth of the hair, from one temple to the other.

		No. of the systematic series.
37.	,, of the mouth - - - - - -	37
38.	Distance between the angles of the lower jaw-bone -	38
39.	,, from the seventh vertebra of the neck to the semi-lunar notch of the sternum (*incisura jugularis sterni*) - - - - - - - -	40
40.	Transverse diameter from one middle line of the axilla above the mamma to the other - - - -	43
41.	Distance from the sternum to the vertebral column -	44
42.	,, from one anterior superior spine of the ilium to the other - - - - - - - -	49
43.	,, from one trochanter major to the other -	50

IV. MEASUREMENTS WITH THE MEASURING TAPE.

44.	Circumference of the head around the external occipital protuberance - - - - - -	29
45.	Circumference of the neck - - - - - -	39
46.	From the greater tuberosity of one humerus, in a horizontal line across the chest, to the other - - -	41
47.	Distance from one middle line of the axilla, above the mamma, to the other - - - - - -	42
48.	Circumference of the thorax at the same place - -	45
49.	Distance from one nipple to the other - - -	46
50.	Circumference of the waist - - - -	47
51.	Distance from one anterior superior spine of the ilium to the other - - - - - - - -	48
52.	,, from the trochanter major to the anterior superior spine of the ilium (on the same side) - -	66
53.	,, from the most prominent point of the sternal articulation of the clavicle to the anterior spine of the ilium - - - - - - - -	51
54.	,, from the most prominent point of same articulation to the umbilicus - - - - - -	52
55.	,, from the umbilicus to the upper ridge of the symphysis pubis - - - - - -	53
56.	,, from the fifth lumbar vertebra, along the crest of the ilium and the inguinal fossæ to the symphysis pubis	54
57.	,, from the seventh vertebra to the terminal point of the os coccygis - - - - - - -	57
58.	,, from one summum humeri across the back to the other - - - - - - - -	55
59.	,, from the summum humeri to the external condyle of the humerus - - - - - -	58
60.	,, from the external condyle of the humerus to the styloid process of the radius across the extensor side -	59
61.	,, from the styloid process of the radius across the back of the hand to the articulation of the metacarpal bone of the middle finger - - - -	60

		No. of the systematic series.
62.	Distance from the same articulation to the top of middle finger	61
63.	Breadth of hand	62
64.	Greatest circumference of the upper arm (round the biceps)	63
65.	„ „ of the forearm	64
66.	Smallest circumference of the same	65
67.	Distance from trochanter major to the external condyle of the femur	67
68.	„ from the external condyle of the femur to the external malleolus	68
69.	„ from the inferior margin of the symphysis pubis to internal condyle of femur	69
70.	„ from the internal condyle of the femur to the internal malleolus	70
71.	Greatest circumference of the thigh	71
72.	Smallest circumference of the thigh	72
73.	Circumference of the knee-joint	73
74.	Greatest circumference of the calf	74
75.	Smallest circumference of the lower part of the thigh above the malleoli	75
76.	Length of foot	76
77.	Circumference of the foot around the instep	77
78.	„ of the metatarsal joints	78

For the better understanding of the following synoptical tables of the craniometrical systems of Virchow, Welcker, C. E. von Baer, and Busk, and of the accompanying figures, I add the subjoined explanations.

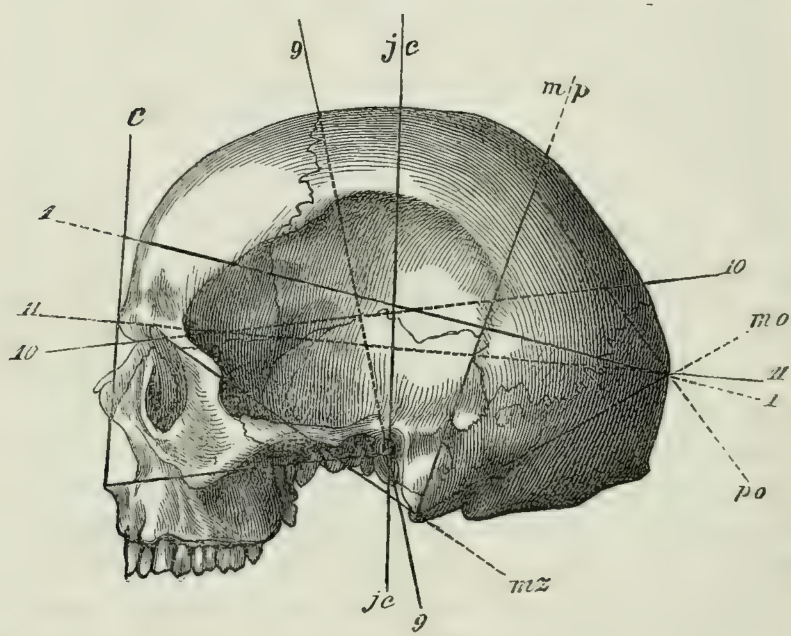
I have only cited systems requiring the simplest instruments, such as a rule about 25 centimetres in length, a measuring tape about 60 centimetres long, a common pair of compasses, callipers, a beam compass, arranged like a shoemaker's measure, having a horizontal bar of 25 centimetres in length, and two vertical arms one of which is fixed at the end, the other sliding along the beam. Such complicated instruments as those designated cephalographs or cephalometers seem to me too much of a good thing.

As Welcker's system is but a further development of that of Virchow, the middle column, which gives the determining points of the measures, refers to both systems, just as the measures of the figures refer to both systems.

I have endeavoured by lines to represent in the figures such measures as figures will admit of. Most of the circumferences can, however, be only demonstrated on the skull or on models. The letters and ciphers belonging to the measures, as marked in the Tables, are always placed at the continuations of the respective measurements outwards.

Fig. 18. Side view of a Helvetian skull from a Roman grave near Geneva, with Welcker-Virchow measurements.

C. C. Camper's facial angle after one method: ear, nasal spine, forehead.



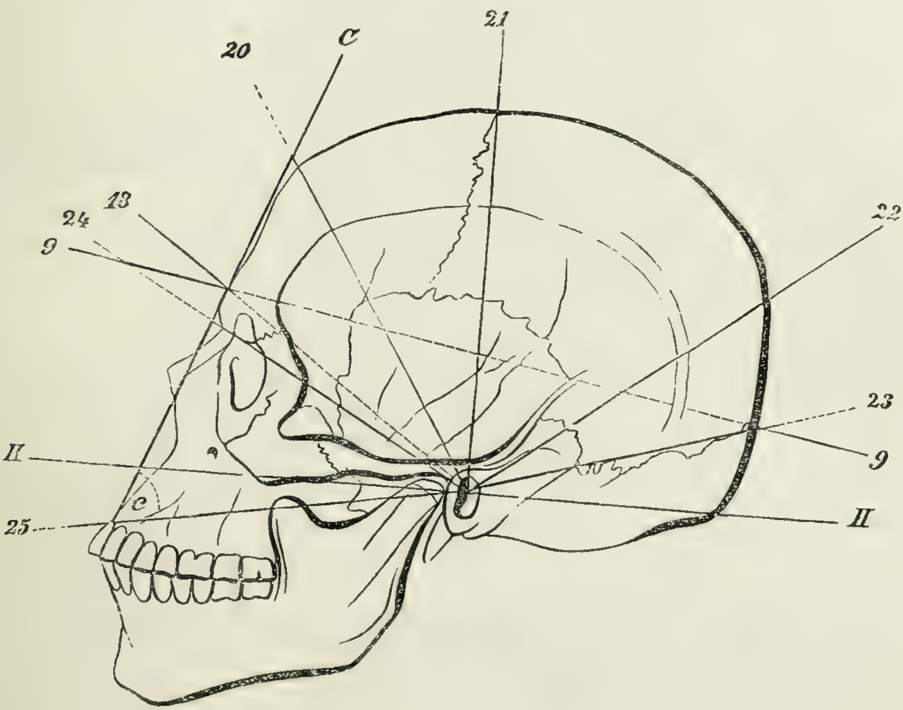
The figures 18, 20, 22, 24, 26, represent the measurements of Virchow and Welcker. Welcker's measurements are plain in the figure, and dotted in the continuation towards the letters. Virchow's measurements, in as far as they differ from those of Welcker, are dotted in the figure and plain in their continuations.

The figures 19, 21, 23, 25, 27, represent the measurements

of von Baer and Busk; those of the latter are plain in the figure, and dotted outwards; Baer's are dotted in the figure and plain outside.

Fig. 19. Side view of a Negro skull, with Baer-Busk measurements.

C. C. Camper's facial angle after the other method: ear, alveolar margin of the upper jaw, forehead.

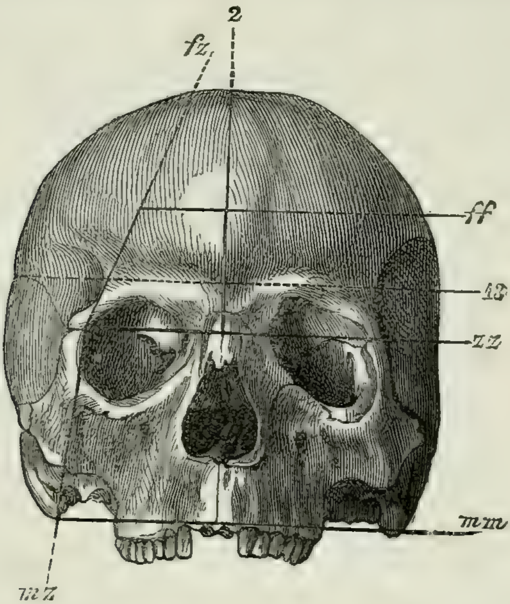


Virchow.			Welcker.	
Names.	Refer. to the figures	Direction and Points determining the measurements.	Refer. to the figures	Names.
		CIRCUMFERENCES.		
Wanting.		Around the frontal and occipital protuberances.	1.	Horizontal Circumference.
Wanting.		That part of the horizontal circumference which is enclosed within the coronal sutures.	1 a.	Frontal Circumference.
Longitudinal Circumference.	2	The central line of the whole skull.	2.	Vertical longitudinal circum.
Frontal suture.	3	From the nasal suture to the coronal suture.	n. c.	Portions of the vertical longitudinal circumference.
Sagittal suture.	4	Length of the sagittal suture.	c. l.	
Occipital squama.	5	To the posterior margin of the occipital foramen in Virchow to the anterior margin in Welcker.	l. b.	
Length of the vertebral bodies.	6	Anterior margin of the occipital foramen to nasal suture in a straight line.	n. b.	
Coronal suture. right / left	7	Anterior transverse circumference.		Wanting.
Lambdoid suture. right / left	8	Posterior transverse circumference.		Wanting.
Wanting.		In a straight line from the margin of the zygomatic process, over the aural aperture, to the same point on the other side over the base of the skull.	j. b.	Basal. Transverse circumference.
		Between the same points over the skull.	j. c. 3.	Upper. Transverse circumference.
Diagonal Circumference.	9	From the aural aperture to the anterior fontanelle.		Wanting.

Carl Ernst von Baer.

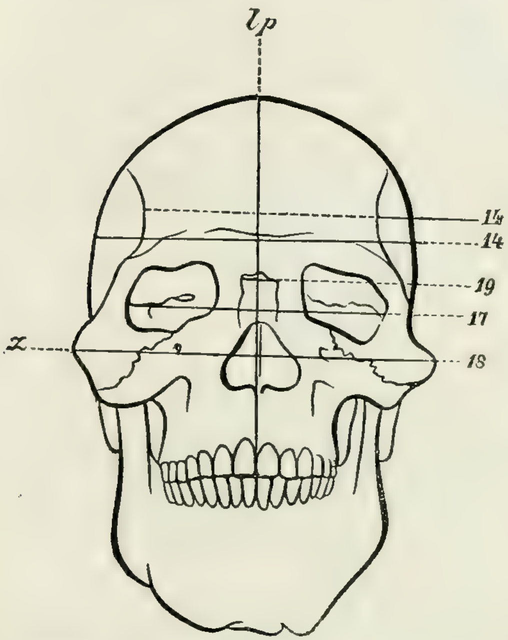
Names.	Refer. to the figures	Directions and Points determining the measurements.	References to Busk's System, and other remarks.
		CIRCUMFERENCES.	
Horizontal circumf. wanting.	1	Across the glabella and the greatest prominence of the occiput.	Horizontal circumference.
Longitudinal circumference.	2	As in Virchow and Welcker.	Longitudinal circumference.
	3		
	4		
	5		
Chord of the longitudinal circumference.	6		
Length of cranial vertebræ.	6 a.	From the anterior margin of the occipital foramen to the foramen cæcum.	
Occipital circumference.	7	From the posterior margin of the mastoid, at the same height as the aural aperture, to the same point on the other side across the vertex.	
Internal circumference.	8	In the bisected skull on the inner side, from the foramen cæcum along the arch, to the foramen magnum.	Wanting in all others.

Fig. 20. Front view of the Helvetian skull—Welcker-Virchow.



Virchow.			Welcker.	
Names.	Refer. to the figures	Direction and Points determining the measurements.	Refer. to the figures	Names.
		DIAMETERS.		
Longitudinal diameter. A.	10.	From the nasal suture to the point of the lambdoid suture.		Wanting.
Longitudinal diameter. B.	11.	From the glabella to the greatest occipital protuberance.		Wanting.
Wanting.		From the middle between the frontal protuberances to the occipital protuberances.	4	Longitudinal diam. Diamet. of horizontal circumference.
Vertical diameter. A.	12.	From posterior border of occipital foramen to the anterior point of the sagittal suture.		Wanting.
Vertical diameter. B.	13.	From the anterior margin of the foramen magnum to highest point of vertex.	6	Vertical diameter.

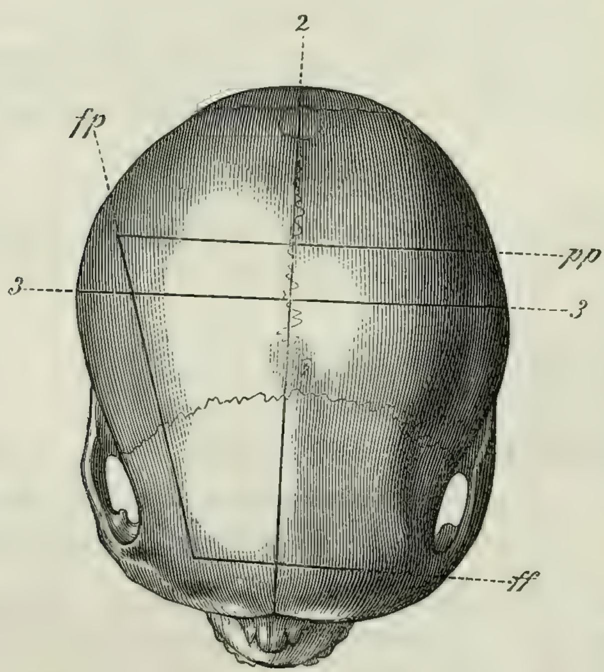
Fig. 21. Front view of a Kaffir skull. Baer-Busk.



Carl Ernst von Baer.			
Names.	Refer. to the figures	Direction and Points determining the measurements.	References to Busk's System, and other remarks.
		DIAMETERS.	
Longitudinal diameter.	9	Same as Virchow's longitudinal diameter B 11.	Length ?
Wanting.			
Vertical height.	10	From the horizontal to the highest point of the vault of the cranium.	The horizontal is the plane of the zygomatic arch.
Height.	11	Same as Virchow and Welcker.	Height ?
Width.	12	Extreme breadth.	Breadth ?

Virchow. Names.	Virchow. Refer. to the figures	Direction and Points determining the measurements.	Welcker. Refer. to the figures	Welcker. Names.
Transverse diameter. Lower frontal.	14	Between the margins of the zygomatic processes of the frontal bone.	z. z.	
Upper frontal.	15	Between the frontal protuberances.	f. f.	
Temporal.	16	Between the points of the alisphenoids.		Wanting.
Upper parietal.	17	Between the parietal protuberances.	p. p.	
Lower parietal.	18	Above the middle of the squamous suture.	s.	Transverse diameter.
Occipital.	19	Betw. the posterior infer. angles of parietal bones.		Wanting.
Mastoid.	20	Between the points of the mastoid processes.	m.m.	

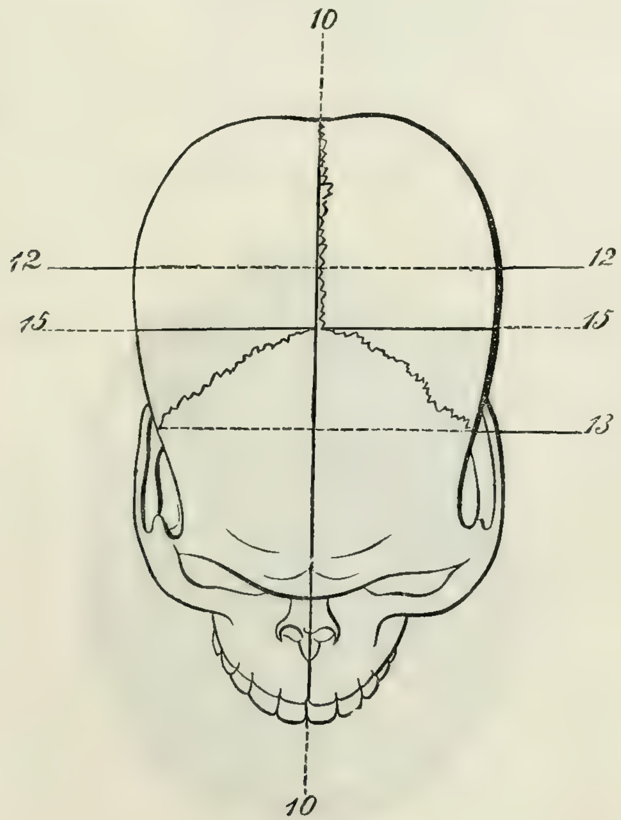
Fig. 22. Top view of the Helvetian skull. Welcker-Virchow.



CARL ERNST VON BAER.

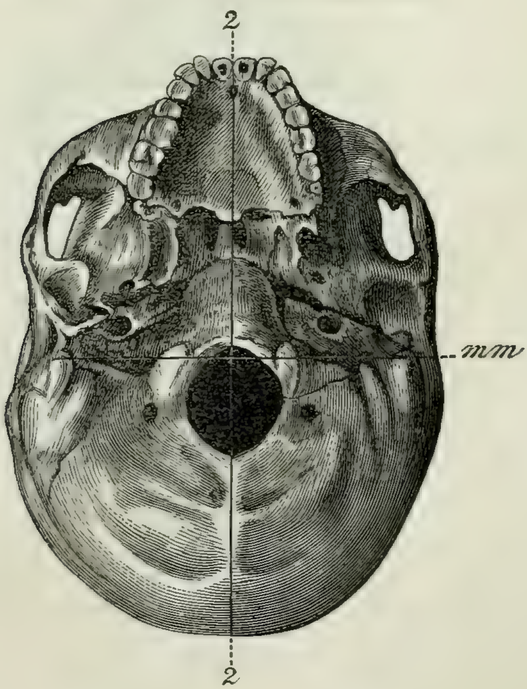
Names.	Refer. to the figures	Directions and Points determining the measurements.	References to Busk's System, and other remarks.
		DIAMETERS.	
Greatest width of forehead.	13	In the coronal suture at the widest spot.	Greatest frontal width.
Least width of forehead.	14	Anywhere.	Least frontal width.
Parietal width.	15	Same as Welcker and Virchow.	Parietal width ?
Occipital width.	16	Between the two points of the mastoid through which the occipital circumference 7 passes.	Occipital width.

Fig. 23. Top view of Negro skull. Baer-Busk.



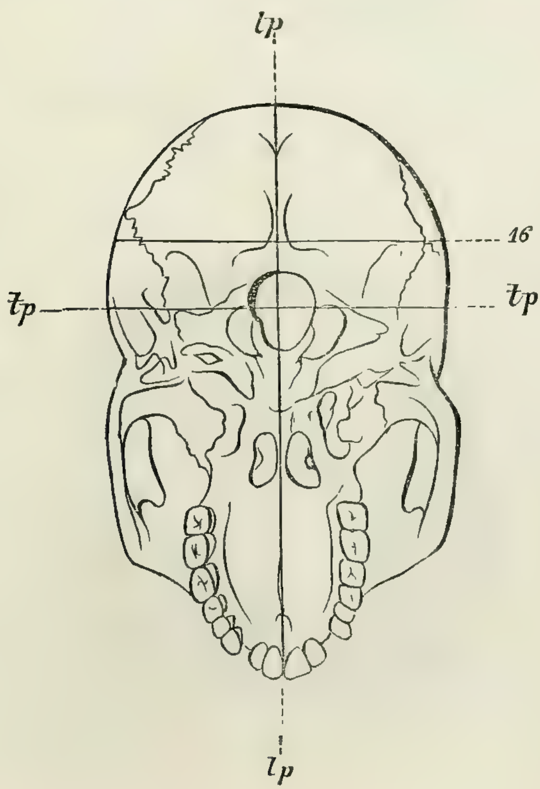
Virchow.			Welcker.	
Names.	Refer. to the figures	Direction and Points determining the measurements.	Refer. to the figures	Names.
		OBLIQUE MEASUREMENTS, To be taken on both right & left sides.		
Wanting.		From the frontal protuberances to the parietal protuberances.	f. p.	
Wanting.		From frontal protuberances to zygomatic process.	f. z.	
Wanting.		From mastoid process to parietal protuberance.	m. p.	
Wanting.		From mastoid process to zygomatic process.	m. z.	
Wanting.		From parietal protuberance to occipital protuberance.	p. o.	
Wanting.		From mastoid process to occipital protuberance.	m. o.	
		The lines *ff*, *pp*, and *fp*, on both sides form the . . .		Upper cranial quadrangle
		The lines *ff*, *zz*, and *fz*, on both sides form the . . .		Frontal quadrangle.
		The lines *zz*, *mm*, and *mz* on both sides form the . .		Basal quadrangle.

Fig. 24. Base of the Helvetian skull.



Names.	Refer. to the figures	Direction and Points determining the measurements.	References to Busk's System, and other remarks.
		RADII.	
Foraminal radius.	17	From the anterior margin of the foramen magnum to the point where the occiput is arched most.	
Frontal radius.	18	From the meatus auditorius to the glabella.	Frontal radius ?
Occipital radius.	19	From the meatus auditorius to the point of greatest arching of the occiput.	Occipital radius.

Fig. 25. Base of Kaffir skull.



Virchow.			Welcker.	
Names.	Refer. to the figures	Direction and Points determining the measurements.	Refer. to the figures	Names.
		ANGLES.		
Not more definitely fixed.		Between a line drawn from the anterior border of the foramen magnum (*b*) to the root of the nose (*n*), and a second line drawn from the nasal spine (*x*) to the root of the nose (*n*).	n	At the root of the nose. (Nasal angle.)
		The three points, *b*, *n*, *x*, give the		Facial triangle.
		Between two lines drawn from the points *b* and *n* to the *ephippium* (*e*).	e	Angle at the *ephippium* (sella angle).
		The three points, *b*, *e*, *n*, give the		Basal triangle.

Fig. 26. Occipital view of the Helvetian skull.

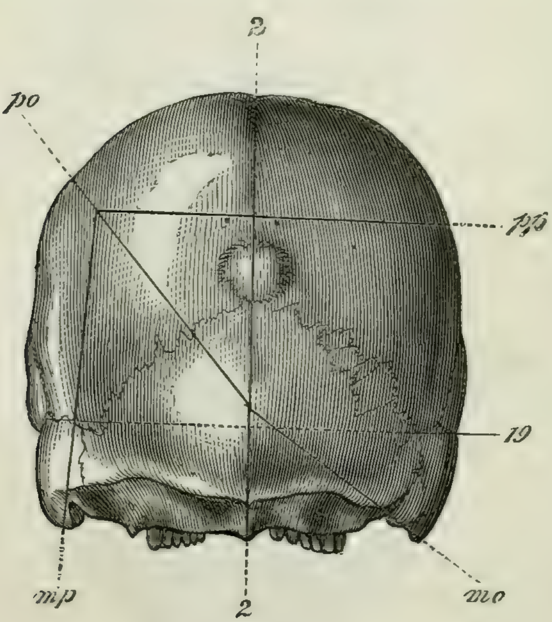
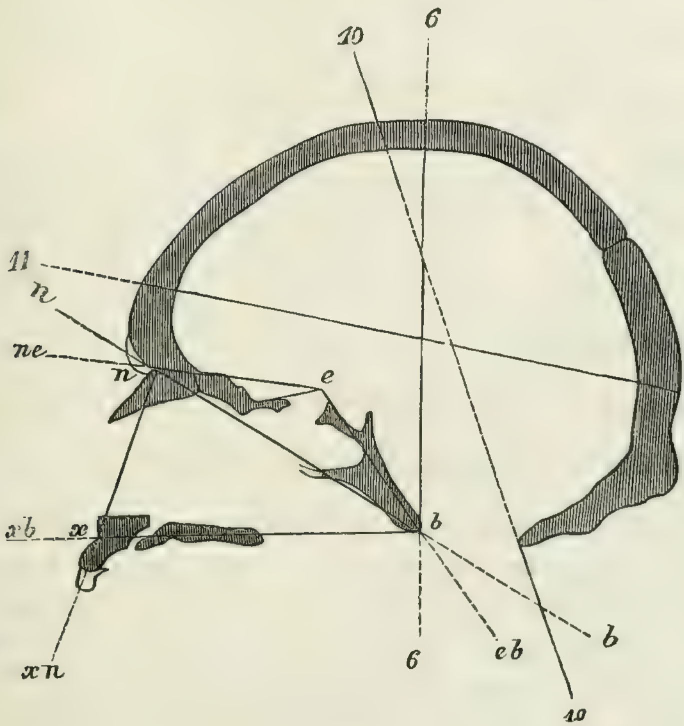


Fig. 27. Vertical section of the skull of an Australian, after Lucae.



Busk's System of Measurement.

See figures 19, 21, 23, 25, 27; pages 61, 65, 67, 69, 71.

Name.	Direction and Points determining the Measurements. References to Virchow and Welcker.	Refer. to the figures
CIRCUMFERENCES.		
Circumference.	. . . . . .	1
Longitudinal arc.	Nasal suture to the posterior margin of the foramen magnum. . .	2
Frontal transverse arc.	. . . . . .	3
Vertical transverse arc.	The two meati auditorii. . .	4
Parietal transverse arc.	. . . . .	5
Occipital transverse arc.	All these circumferences of arcs are taken in the direction of the radii of the same names. . .	6
Longitudinal frontal arc.		7
Longitud. parietal arc.		8
Longitud. occipital arc.	. . . . .	9

Names.	Direction and Points determining the Measurement. References to Virchow and Welcker.	Refer. to the figures
DIAMETERS.		
Length.	. . . . . .	10
Breadth.	. . . . . .	11
Height.	. . . . . .	12
Least frontal breadth.	. . . . . .	13
Greatest frontal breadth.	. . . . . .	14
Parietal breadth.	Upper parietal diameter, V. *p p.*; W. ?	15
Occipital breadth.	Occipital diameter, Virchow ? . .	16
Orbital breadth.	Lower frontal diameter, V., *z z*, W. ?	17
Zygomatic breadth.	. . . . . .	18
Ethmoidal breadth.	. . . . . .	19
RADII.	All radii are taken from the meatus auditorius.	
Frontal radius.	*Glabella.*	20
Vertical radius.	To anterior point of sagittal suture. .	21
Parietal radius.	. . . . . .	22
Occipital radius.	. . . . . .	23
Fronto-nasal radius	To nasal suture. . . .	24
Maxillary radius	To alveolar margin of the upper jaw. .	25
Horizontal plane	Through the floor of the nasal cavity.	H.

LECTURE III.

Pictorial representations.—Ethnic portraits generally Caricatures.—Photographic Drawings.—Perspective delineations.—Geometrical Drawings after Lucae.—Instruments required.—Casts.—Casts of the internal Cranial surface.—Proportions.—Sexual differences in the formation of the Cranium.—Examination of the Brain.—Weight.—Weight of the Brain in relation to the body.—Estimation of the Cranial Capacity.—Method and results.—Broca's researches on Parisian Skulls.—Increase of Cranial Capacity in relation to Civilisation.

Gentlemen,—Before proceeding to those investigations which relate to the internal capacity of the cranium, and to the central organ of the nervous system, I have to offer some observations on pictorial and plastic representations, which, in addition to descriptions and measurement, form essential elements in instruction. Much discussion has recently taken place as to the mode in which the skull should be portrayed, and as the principles of cranial delineation apply to other objects of natural history, a few words on this subject may not be out of place.

It cannot be denied that most ethnic delineations which have recently appeared, whether of living men or of skulls, have very little or no value. Many of the drawings from living individuals are perfect caricatures unconsciously perpetrated by the artist, since even the practised painter, in order to give prominence to the individual resemblance, exaggerates the features peculiar to the individual. These features are frequently not those characteristic of the race, as such; often, too, just those features which belong to the race, and which strike the painter, are too much exaggerated; and frequently the race peculiarities are suppressed in order perfectly to effect the resemblance to the individual.

Independently of these disadvantages, the position in which the head, or the cranium, is to be portrayed, is of special

importance. For purposes of comparison (and all pictorial representations used in natural historical researches must be comparable *inter se*), strictly geometrical drawings are requisite, as they admit of the object which is to be compared with the delineation being brought into the same position in which the drawing has been taken.

For the delineation of the living head there are mostly only two aspects which can be relied upon, viz., the profile and the full front view, and these the artist rarely selects. With regard, then, to ethnic portraits taken from life, we may boldly assert that most of them have no scientific value, but are more likely to mislead and to direct our attention to subordinate points.* I say this, not only with regard to the position of the subject, but also to the management of the light which, in photography, constitutes the most essential element, and by means of which prominent parts may be entirely suppressed, and insignificant parts rendered prominent. The travelling naturalist who undertakes such investigations, should, therefore, be a very expert photographer to overcome such difficulties. If this be effected, there can be no doubt that photography is the best means of obtaining ethnic pictures in great numbers; as science requires, in order to establish the mean type, not individual characteristic faces, but a multitude of them.

Photography, in which the ray of light, subject to unalterable physical laws, takes the picture, and not the erring hand of man, is the only means of obviating one of the greatest obstacles in the study of anthropology, by enabling us to compare objects separated by time and space. The soft parts of the head and the whole body are, in many cases, of considerable importance. I need only mention the shape of the nose, the lips, the aperture of the eyes, the position and shape of the ear and the lobule, as well as of the beard and the hair. But most of these parts are perishable, and cannot be preserved in their original form. Without

* With regard to living individuals, photography is undoubtedly one of the most invaluable aids to study, provided it is skilfully used.

photography, it is only the subjective conception of the designer which can serve as a means of comparison. Generally we cannot place races side by side. Naturalists sail or steam round the world; they observe one race or tribe, then, after weeks, or perhaps months, they see another, and, from memoranda and sketches, try to discover resemblances and to institute comparisons. The zoologist, who is required to institute a comparison between two similar animals—the one from Africa, the other from Asia—and to determine from memory, or from notes and drawings, whether or not they belong to the same species, shrugs his shoulders and says, "Show me the animals side by side, or at least the skin and the skeleton, but do not ask anything unreasonable." Nevertheless, this demand is frequently made of the anthropologist. Though photography cannot place the races themselves side by side, it, to a certain extent, supplies the want of them by the exactness of its delineations.

With regard to the delineation of the skull, there are two points of view, and the opinions of naturalists vary accordingly. If the object be to obtain figures which are to represent the character of the skull and its peculiarities, so as to strike us at the first glance, perspective delineation, which is to be obtained most perfectly by means of photography, is to be preferred above all others, as it best renders the peculiar physiognomy of the original. But when a recent author recommends, in the portraiture of the skull, positions of half or one-third profile, according as either of these positions is most characteristic, it seems to us a mistake, because one of the chief objects of delineation, viz., comparison, is ignored. When Welcker, for instance, gives a skull with an open frontal suture and widely-distant orbits four-fifths full face, and somewhat inclined to the left side, we cannot see that such a distorted position better represents the peculiarities of formation depending on open sutures, the position of the eyes, &c., than a full front view. If we compare with these the excellent photographic delineations of Von Baer, it can easily be seen, that even in strictly geometrical positions, the characteristics of cranial formation can be better rendered than by the method just mentioned.

But if it be requisite to have drawings which are not merely comparable but measurable,* then the geometrical method recommended by Dr. Lucae, of Frankfurt, must be applied. This consists simply in this, that the object is not drawn from a fixed point of view, so that the rays of light emanating from it meet in the eye as in the summit of a cone, but that, on the contrary, the eye constantly changes its position, and forms the representation of the object by means of the parallel, horizontal, or vertical rays emanating from it. In perspective delineation, which is also that of the photographic instrument, the individual parts of the body to be depicted are greatly foreshortened, according as they form projections or depressions; in the geometrical delineation everything is in the place which it occupies in the original, with regard to the plane upon which the image is projected. The various cranial measures reducible to a plane, may certainly be measured on such geometrical drawings with compass and meter-scale; but only these—and when Lucae asserts that these measurements can supply the place of actual measurements on the skull itself, we can only ascribe such an assertion to his exaggerated predilection for a method which certainly is not without its advantages.†

It must also be admitted that geometrical drawing offers very great difficulties to any one who is accustomed to ordinary drawing, and that in practising it one must abandon all the rules one has hitherto followed, and consent to become a mere machine, which does nothing but mark with pencil or pen the point which indicates the perpendicular ray. Lucae has recommended two instruments, one constructed by himself, the other by a Herr Wirsing. In both the fundamental principle is the same: a diopter fastened to a perpendicular arm is placed upon a horizontal glass plate, beneath which is the object.

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* Compare Crull., *De Cranio ejusque ad faciem ratione*, 8vo, Gröningen, 1810.—Editor.

† Lucae does not propose to substitute measurements from geometrical drawings for measurements taken on the skull itself; he merely says, speaking of the difficulty and uncertainty in obtaining several necessary cranial dimensions, "that they can be taken on such drawings with greater rapidity and certainty than *in very many cases* from nature itself." See *Morphologie der Rassenschädel*, Frankfurt, a. M., 1864, part ii, p. 3.—Editor.

In Lucae's instrument the perpendicular ray is given by the intersection of two crossed threads, the point of the pen having to be placed in the same vertical line as the point of the object to be delineated. In Wirsing's instrument the point of the pen is fixed perpendicularly under the minute aperture of the diopter. The glass plate being adjusted in the horizontal plane, and the skull so placed that the plane upon which the delineation is to be projected, runs parallel with the glass plate, we draw the lines and points upon the glass plate, by moving the instrument thereon in the requisite directions.

I possess Lucae's instrument, and having practised with it for some time, must say that one may, in a comparatively short time, obtain by it a correct outline, which is, however, somewhat coarse, as the glass plate but imperfectly takes up the liquid whether it be common or lithographic ink. In the practical use of this instrument it is especially requisite to pay attention to the distribution of the light. Whilst for other drawing purposes a side light is preferred, and studios have only one large window for the proper distribution of light and shadow, geometrical drawings, on the other hand, should be taken in a glass house, where all is light, and there is no shadow. The fine aperture of the diopter, too, through which we look, cuts off so much light, that when the light comes in from one side, the black threads, or the point to be drawn on the darker side of the object is invisible, and we thus have an imperfect drawing. To obviate this, I have often artificially illuminated the dark side by means of a candle or a lamp; but this is only a poor expedient, and becomes further objectionable on account of the glass plate often becoming heated. A mirror conveniently arranged will, as Lucae rightly observes, serve the same purpose. Though geometrical drawing, so long as it is given in natural size, admits of some measurements being taken as easily as on the object itself, it cannot be denied that, to common observation, it presents an apparently incorrect image, and that our common mode of viewing objects corresponds more to the perspective than the geometrical. Strictly speaking, it corresponds to neither, and stereoscopic views alone can render the image of the skull as

we see it with our eyes. Many years, however, will elapse before they will be used for scientific purposes; until then, naturalists must agree to apply photography for ordinary delineation, and the geometrical method for drawings which are required to be comparable by measurement.

Casts, as well of living persons as of dried skulls, if they are carefully prepared, may, in many cases, entirely supply the place of the originals. In the case of nations who shave the whole, or nearly the whole, head, complete casts of the head may be taken from the living. The masks are generally less useful than the casts of the head, as the forced positions of the closed eyes and lips, as well as the unpleasantness of the contraction of the drying gypsum, contorts the features.

It cannot have escaped you, that the various cranial measurements by compass, measuring-tape, and rule, give but an imperfect idea, and indeed only some of the principal dimensions of the head. If both the exterior and interior of the skull are to be represented completely by measurements of this sort, a very great number of measurements must be taken, which would be objectionable, owing to the necessary indefiniteness of their terminal points. Other means had therefore to be contrived to measure the internal capacity of the skull, with a view to the formation of conclusions as to the development of the brain and its component parts. The various substances used for this purpose may be divided into two categories: such as serve to indicate the capacity of the skull, irrespective of the size and shape of individual parts; and such as show this shape and the proportion of the individual parts to each other. Tiedemann closed the apertures of the cranium with wax, placed it upon the vertex, and then filled the cavity with millet seed, shaking them till they were at the level of the occipital foramen. He then weighed them, and using them for other similar measurements, he obtained weights which, though comparable with each other, could not be adopted by other observers, there being no certainty that the millet-seeds used by them were of the same size or degree of dryness* as

* Sand, of a recognised specific gravity, and carefully dried, is the substance most frequently employed in England.—EDITOR.

those used by Tiedemann. Morton used peppercorns or shot, and, instead of weighing, he measured them, by which he obtained the advantage that measure corresponded to measure and not to weight. Huschke used water, measuring the quantity requisite for filling the skull; here, of course, the temperature of the water must be attended to. The results thus obtained I shall presently indicate.

There can be no doubt that skull and brain exercise a reciprocal influence as regards development; that they grow with each other, but that the details of the superficial formation depend on the mechanical action of the brain. The inner surface of the skull represents, therefore, the impress of the surface of the brain, but, be it understood, of the brain invested with its integuments. Now, the hard, external membrane of the brain, the so-called *dura mater* of anatomists, forms a covering, which passes above the inequalities and the convolutions without entering into the depressions which separate them. A cast, filling the cranial cavity, and preserving its shape after removal, will therefore represent only the coarser features of the brain, but not the minute details. There has been a great deal of dispute as to the substance best fitted for this purpose. To supply, says Huschke, the want of brains of various nations, I have made wax models from the crania of a Carib, Cossack, etc., which afford some idea of the convolutions. Wagner used gypsum, Lucae glue; the latter is of opinion that there is no substance more suitable for rendering the form, size, and circumference of the brain.* Gypsum has, however, the advantage of retaining the form of the effusion, whilst glue only retains it for a few days. Both substances have the disadvantage of uniting with water in different quantities, and consequently vary in weight. Hence,

* Compare Flower on "The Brain of Siamang," *Nat. Hist. Rev.*, 1863, for details of the method employed by him in the preparation of the series of casts in the Royal College of Surgeons by the use of a composition of glue and treacle.—EDITOR.

In the second part of *Zur Morphologie der Rassenschädel*, Frankfurt, 1864, Lucae recommends the use of seed, as he finds that the specific gravity of the glue-casts varies so greatly, even when taken from the same liquid mass, that it is quite impossible to determine the volume of the brain by means of such casts with anything like accuracy.—EDITOR.

the different parts of the same plaster, or glue, casts may be compared with each other, but not different gypsum, or glue, casts, made at different times and with different materials. The most unobjectionable substance in this respect would be a metallic alloy which melts at the boiling-point of water. We could then obtain, not merely the external form, but also the weight, the specific gravity of the alloy having been determined. I do not, however, intend to take out a patent for the discovery of a material for taking casts of the skull cavity; for, if we go a little further into the matter, we find that it was not an anatomist, but a physicist, who deserves the credit of having first made use of such a substance. Lichtenberg, in the famous auction catalogue of the curiosities of a deceased gentleman, mentions a butter-dish in the form of a skull, having the inner surface of the cover so modelled that it impressed upon the butter the exact form of the brain!

The measurements of Welcker have shown that, in the structure of the skull, a tendency generally prevails to establish, even when there is a considerable variation in total mass, a nearly equal internal capacity. There also exists a certain proportion between the size of the skull and that of the body, although the proportion is not always the same for different degrees of stature. Thus, though giants have generally a larger skull than dwarfs, it is proportionally smaller in the former than in the latter. Besides, the large skulls incline rather to length, at the same time decreasing in width; while small skulls become more rounded, thus acquiring that form which, for a given external surface, affords the largest internal space. From long skulls of considerable size we may, therefore, generally infer that their possessors were tall, muscular men, and it is known that among the Negroes, who are characteristically long-headed, we frequently meet with strikingly athletic forms.

This will be the proper place to make some remarks on sexual differences which occur within the same species and variety, and which have hitherto not received the attention they deserve. You are aware that, in the animal kingdom, there are many instances in which this difference is so great,

that both sexes would not be included in the same genus, much less in the same species, if their relations to each other were not ascertained. It would have occurred to no naturalist to associate the beautifully decorated cock pheasant or peacock with their plainer mates, if their sexual relations were not known, and I might quote hundreds of instances occurring among mammals and the anthropoid apes, in which sufficient sexual differences occur to justify their arrangement in different species. Thus it is with the orang, the baboon, howling monkey, and other apes, more or less approaching man in structure. When, therefore, Welcker justly observes, that the skulls of man and woman are to be separated, as if they belonged to two different species, and that they differ in their proportions more than many typical or race skulls, he gives expression to a fact in nowise peculiar to the human species, but one that finds its counterpart in the mammalia, and especially in the anthropoid apes. According to Welcker, the female skull is smaller, both as regards horizontal circumference and internal capacity, and the weight of the brain corresponds with this. The female skull exhibits, according to Welcker's measurements, the following proportions, assuming the male = 100 throughout:—circumference = 96·6; capacity = 89·7; weight of brain = 89·9. The outlines of the female head are rounder; the facial portion of the skull, especially the jaws and the base of the skull, smaller, the latter being especially narrower in the posterior section. The base is at the same time more extended, the sella-angle larger; and there is developed in the female a striking tendency to prognathism as well as to dolichocephaly. We may, therefore, say that the type of the female skull approaches, in many respects, that of the infant, and in a still greater degree that of the lower races; and with this is connected the remarkable circumstance, that the difference between the sexes, as regards the cranial cavity, increases with the development of the race, so that the male European excels much more the female than the Negro the Negress. Welcker confirms this statement of Huschke from his measurements of Negro and German skulls; more observations are, however, requisite before it can be accepted as generally true.

If it were proved to be correct, it would furnish an interesting indication of the influence of civilisation and mode of life on the development of races. It has long been observed that, among peoples progressing in civilisation, the men are in advance of the women; whilst amongst those which are retrograding, the contrary is the case. Just as, in respect of morals, woman is the conservator of old customs and usages, of traditions, legends, and religion; so in the material world she preserves primitive forms, which but slowly yield to the influences of civilisation. We are justified in saying, that it is easier to overthrow a government by revolution, than alter the arrangements in the kitchen, though their absurdity be abundantly proved. In the same manner woman preserves, in the formation of the head, the earlier stage from which the race or tribe has been developed, or into which it has relapsed. Hence, then, is partly explained the fact, that the inequality of the sexes increases with the progress of civilisation. To this must be added the circumstance, that the lower the state of culture, the more similar are the occupations of the two sexes. Among the Australians, the Bushmen, and other low races, possessing no fixed habitations, the wife partakes of all her husband's toils, and has, in addition, the care of the progeny. The sphere of occupation is the same for both sexes; whilst among the civilised nations, there is a division both in physical and mental labour. If it be true that every organ is strengthened by exercise, increasing in size and weight, it must equally apply to the brain, which must become more developed by proper mental exercise.

Passing now to the brain itself, we have already remarked that an opportunity for comparative ethnological investigations is rarely met with. The organ is so soft, so dependent in its form on its integuments, that its general measurements can neither be taken from the fresh nor the indurated brain, but only from casts, with any degree of accuracy. On merely removing the calvarium, leaving the brain in the skull, we can only take measurements, such as the longitudinal and transverse diameters, which are just as easily obtainable from the calvarium. If the brain be removed, we find that it sinks and

becomes flattened by its own weight; in short, changes its form, despite of all efforts to support it. The mass is so rapidly decomposed, that, in order to study the various parts, it must be indurated in some such fluid as spirits of wine. In short, there are a variety of circumstances which render comparative investigations of this organ specially difficult, so that we must proceed with the greatest accuracy and caution.

The weight of the brain has been especially taken into consideration, and the investigations of the English have, in this respect, been conducted on a much larger scale than those of the French and the Germans. Thus Dr. Boyd weighed not merely the brains, but also the other organs, of 2,086 males and 1,061 females of all ages; whence it resulted that in the adult the male brains varied from 1,366 to 1,285 grammes, and the female brains from 1,238 to 1,127 grammes, so that the highest cerebral weight of the female is much less than the lowest in the male. Among the insane (528 cases were investigated) the variations in the weight of the brain are much greater than among such as died from other diseases; and it seems to us that such investigations ought to be pursued on an extensive scale, and in detail. There are cerebral diseases, or psychical disturbances, such as mania, connected with great exaltation of cerebral activity; whilst there are other mental states in which the cerebral activity is evidently diminished. Very possibly the greater variation in weight may depend on such alternate conditions; but this, however, can only be clearly ascertained from a great number of observations. Thus, in Wagner's tables of the weights of various brains we find by the side of intellectually gifted men such as Cuvier, brains of insane and hydrocephalic subjects, in whom the cerebral substance itself was evidently affected.

Regarding the question of the possible development of the brain, it becomes important to note the relation of the size and weight of the cerebral mass to the intelligence of the individual. It has been generally observed, that highly gifted individuals possess a comparatively large skull, an opinion which prevails among the people generally, especially in France. I have, hundreds of times, heard the expression, "a good head,

a capital head," which did not apply to the performances of the person, but merely to the external shape; and I have convinced myself, by actual inquiry, that the common people draw their inferences as to the intellectual capacity from the size and shape of the skull, and especially of the forehead. In fact, actual measurements have shown that many highly gifted individuals, among whom I may mention Cuvier, Schiller, and Napoleon I, possessed, in proportion to their height, very large skulls, and consequently highly developed brains.

Wagner, of Göttingen, has published a rather large table of cerebral weights, among which may be found those of many highly gifted persons; and he has based on this table the assertion, that there is no good ground for the above theory, inasmuch as the brains of Hausmann and Tiedemann, who occupied an eminent position in science, were under the average weight. Exceptions, however, only prove the rule; and besides, both the abovenamed philosophers died at a great age from exhaustion of the vital powers, in consequence of which all organs, and certainly the brain also, became atrophied. Observations have not, however, been sufficiently numerous to justify the positive assertion of the diminution of the brain in old age, though the possibility of such a thing in man, as well as in apes, is undeniable. I have before me two skulls of the same species of baboon; one belonged to a male which perished at the period of dentition; the other, to another male which had reached maturity. The internal capacity of the young skull is not only relatively, but absolutely larger than that of the old animal,* so that unless it depended upon individual variation, the old skull must have suffered a reduction. Such a reduction can, of course, only be positively established by a great number of measurements, for which I have not the means. The same relation seems, however, to obtain among other apes. Thus, Welcker gives delineations of three orang skulls,† which, on close examination, show that the youngest skull has apparently the largest internal cranial capacity. But if such be the case, there is no reason why the diminution of the skull, which com-

* Similar instances amongst apes are very frequent.—Editor.
† Compare Brooke, Owen, and Wallace.—Editor.

mences at an earlier period in the ape, should not take place in advanced age in man.

Parchappe, who has made a number of cranial measurements on his own system, asserts that the cranium increases up to the fiftieth year, but considerably diminishes after the sixtieth; that the diminution takes place especially in the frontal region, corresponding to the anterior cerebral lobes, and that the frontal sinuses enlarge after the sixtieth year. Theile has observed, that that sphere of life in which we especially look for intelligence embraces two classes of intelligence; the one original; the other, acquired by education, and which, under lower social conditions, would not have risen above the common level. A distinction must certainly be made between creative minds, such as that of Gauss, which open new roads to science, and such minds as that of Hausmann, which proceed in the beaten path, and whose names, though occupying high positions during life, soon disappear from the history of science. We must not forget that the solution of this question is, as Welcker observes, to a certain extent invidious. Anthropologists, with large heads, may feel inclined to adopt one view, whilst those less favoured will accept the opposite theory.

There is no doubt that, in every race and species of man and animals, there obtains a definite law as regards the proportion and weight of the brain to that of the body; but this can only be determined from numerous observations. At all events, it is certainly erroneous to lay down absolute rules as to the proportion between the weight of the brain and of the body. The weight of the body varies, as is well known, greatly according to the nutrition and nutritive decomposition to which an animal is exposed. If the increase during fattening, or the diminution during starvation, affected all parts in a similar degree, the proportion of the weight of the brain to that of the body would remain the same. We know, however, that such is not the case; and the accurate investigations of Chossat have shown that the brain is just the very organ which proportionally loses least weight from starvation. The poorer the alimentation of an animal, the greater is the proportional weight of the brain, and the greater should be its intellectual function if it depended on such a condition. Hunger, no

doubt, sharpens the wits as well as the teeth, and according to Horace, growing fat is a mark of incipient stupidity.

Formerly, the opinion prevailed that man possessed a brain absolutely heavier than that of any other animal. This is true as regards most animals; but intelligent colossals—such as the elephant, and we may also add, the whale—soon proved the axiom to be unfounded. If, it was then said, it be not the absolute, it is the relative, weight. The weight of man's body compared with that of his brain is, on the average, as 36 to 1; whilst in the most intelligent animals it is rarely above 100 to 1. Whilst in the former case it was the giants, it was now the dwarfs of creation which upset the axiom. The host of small song birds vary as regards this proportion, within limits which far exceed the normal proportion in the human race. The small American monkeys, too, exhibit a proportionally heavier brain than that of the lord of creation. If, then, the weight of the brain is to be compared with any other numerical factor in the body, it can only be a measure of length, which, although subject to variation, is so in a much less degree, and it might, perhaps, be best to adopt the length of the vertebral column as the standard. On adopting the whole length of the body, that of the legs is included, and it is just the length of the legs which exhibits the greatest variations. The trunk of man varies much less, and this offers a much more accurate standard. Moreover, measurements of the whole length of the human body can never be compared with those of mammals, none of them possessing an erect stature, but their posterior limbs forming invariably a greater or lesser angle with the axis of the vertebral column.

We possess at present only the weights of the brains of the tribes of central Europe,—Germans, French, and English,—in any considerable numbers, and these are so arranged that they require further critical sifting. The table furnished by Wagner is a crude, undigested mass; and those who would draw inferences from it must subject it to a close sifting, as sex, age, and diseases are curiously intermixed. This much may, however, be inferred from it, that although there is no definite mathematical proportion, there is an approximative relation between the weight of the brain and the development

of intelligence; and Broca has shown, from Wagner's table, that, excepting the brain of Hausmann, all the brains of noted or celebrated individuals excelled the average weight of those of unknown persons, and that the brains of Wagner's colleagues, weighed by himself, occupy the first rank in the series, if arranged according to weight. This is a point of very great importance; for after all, only such brains as have been weighed by the same observer, after the same method, can be compared with each other. A difference of fifty grammes or more may easily be caused by the way in which the brain is prepared; and in most cases experimenters give no clear explanation of their mode of preparing the brain previous to weighing. Whilst, then, men occupying the same rank of intelligence may have brains of different weights, and privileged individuals may sometimes possess lighter brains than others who are noways distinguished from the common horde, it still remains an established fact that, generally speaking, there is an approximative relation between cerebral weight and intelligence, and that the determination of this relation should on no account be neglected.

The result of these investigations enables us definitely to assert, that a certain weight of brain is requisite for the manifestation of intellectual faculties; that idiocy and mental weakness begin below this weight; and that this weight, as regards the white race, or central European nations, is about a kilogramme for the male, and 900 grammes for the female. We shall recur to this point when treating of the relation of idiots with arrested cranial and cerebral development to the simian type.

I have purposely stated, that the lowest normal weight quoted only applies to the central European peoples; whether to the white race in general is yet doubtful. The more we specialise in such matters the better; and as it is scarcely determined whether the white race forms really a united whole, or is not a mixture of various species, it is as well to confine ourselves strictly to data before us. Direct investigations relating to other races, which no doubt have their peculiar standard, we do not yet possess. We are necessarily confined, for the present at least, to measurements of the internal capacity of the skull. Even with regard to this, erroneous results were

formerly propagated by Tiedemann. Supported by few and erroneously interpreted observations, Tiedemann asserted that the cranial capacity of the Negro was not less than that of the European, and this assertion was naturally turned to profitable account by monogenists. More numerous measurements are now available, and their results, as far as they are known to me, I have arranged in the following table. They have all been taken according to Morton's method, by filling the skull with small shot, and ascertaining the measure in cubic centimeters.

CRANIAL CAPACITY IN VARIOUS RACES.

No.	People.	No. of skulls measd.	Volume in cubic centimeters.	Observers.	Remarks.
1	Australians.	8	1228·27	Aitken Meigs.	
2	Polynesians.		1230	Morton.	
3	Hottentots.		1230	,,	
4	,,	3	1233·78	Aitken Meigs.	
5	Peruvians.*	152	1233·78	,,	* [With artificially compressed skulls. —EDITOR.]
6	,,		1246	Morton.	
7	Oceanic Negroes.	2	1253·45	Aitken Meigs.	
8	Mexicans.		1296	Morton.	
9	Americans in general.	341	1315·71	Aitken Meigs.	
10	Negroes born in America.	12	1323·90	,,	
11	Malays.		1328	Morton.	
12	Mexicans.	25	1338·65	Aitken Meigs.	
13	Greenlander.	1	1340	Welcker.	
14	Chinese.		1345	Morton.	
15	Negroes in general.	76	1347·66	Aitken Meigs.	
16	,,		1361	Morton.	
17	Ancient Peruvians.		1361	,,	
18	Negroes born in Africa	64	1371·42	Aitken Meigs.	
19	Wild Indians.	164	1376·71	,,	
20	Parisians, from a common grave.	35	1403·14	Broca.	Skulls of the 19th century.
21	Parisians from the Cimetière des Innocents.	117	1409·31	,,	Skulls of the 12th to the 18th century.
22	Esquimaux.		1410	Morton.	
23	Parisians of the 12th century.	115	1425·98	Broca.	From a Vault.
24	Caucasians in general	1	1427	Aitken Meigs.	
25	Malays.	1	1430	Welcker.	
26	Germans.	30	1448	,,	
27	Parisians of the 19th century.	125	1461·53	Broca.	
28	Anglo-Americans.	7	1474·65	Aitken Meigs.	
29	Parisians from private graves.	90	1484·23	Broca.	Skulls of the 19th century.
30	Parisians from La Morgue.	17	1517	,,	The same.
31	Germans in general.	38	1534·127	Aitken Meigs.	
32	Brachycephale, from Meudon.	1	1540	Broca.	From a Dolmen.
33	English.	5	1572·95	Aitken Meigs.	

This list requires some explanation. The results arrived at by Morton and Aitken Meigs have been obtained, to a great extent at all events, from the same skulls, namely, from Morton's collection of crania, which was purchased by the Academy of Science in Philadelphia, and has since then received but few additions. Some of the differences between the above observers may have arisen from the circumstance that the measures originally given in English cubic inches, were differently reduced to cubic centimeters. These measurements, as well as those of Welcker, were made with small shot, with which the cranium was filled, and shaken until no more could be introduced.

Broca has observed, that no exact measurement is obtained by this method, the differences arising when the same skull is measured several times, amounting to from twenty to thirty-five cubic centimeters, owing to the fact that, in many skulls, some parts of the internal cavity of the cranium rise above the level of the occipital foramen, through which the shot is introduced. Broca, therefore, by means of a long cuneiform instrument, presses the shot in every direction, until no more can be introduced. His results, though comparable with each other, present therefore somewhat higher numbers. Again, the skulls examined by the American observers were selected specimens, whilst those of Broca were obtained from disturbed churchyards.

Broca availed himself of the rare opportunity of examining a number of skulls which were found in Paris, on laying the foundation of the new *Tribunal de Commerce*, in a vault, at a depth of three meters, at a spot which was already covered with houses at the time of Philip Augustus. The crania must therefore, at the latest, date from the twelfth century, many of these possibly from the Carlovingian period. They certainly belonged to individuals of the higher ranks, as they were found in closed vaults; and they present two distinct types,—long-heads and short-heads, as well as a larger number of medium-heads, which possess the least capacity; whilst the long-heads occupy, in this respect, the middle position between the medium- and the short-heads, the latter occupying the highest position. All these skulls are marked as Parisians of the twelfth century in the table.

A second series of skulls was obtained by Broca from an old churchyard, *Cimetière des Innocents,* which was opened under Philip Augustus in the twelfth century, and used up to the eighteenth century. Finally, a third series was obtained from a more recent churchyard, the *Cimetière de l'Ouest,* used from 1788 to 1824. The skulls are indicated in the table as Parisians of the nineteenth century. Both these churchyards served chiefly for the poorer classes; but Broca was enabled to form three series of the skulls of the *Cimetière de l'Ouest*; namely, crania from the pit, in which the bodies were buried after having been exposed in the *Morgue,* and which consequently belonged chiefly to suicides, and unknown persons accidentally killed; skulls from the common pit where paupers were buried; and lastly, skulls from private graves, for the preservation of which a fee was exacted, and which consequently were the skulls of people of some means, who, it may be assumed, were better educated than the others.

On comparing Broca's results, we find first that the skulls of suicides exhibit the highest average, which may, perhaps, be explained by the fact that in most of these cases cerebral diseases may have been the cause of the act of self-destruction. But what is more striking is the difference between the skulls obtained from the common pit and those from private graves; for it amounts to above eighty cubic centimeters,—a large amount, considering that the total capacity does not amount to 1,500 cubic centimeters. We may hence infer that individuals engaged in art and science possess a higher cranial capacity than mere labourers,—a result which is confirmed by other observations to which we shall recur.

Broca's observations yield, moreover, the remarkable result, that the cranium of the Parisian population has, in the course of centuries, gained in capacity. On comparing the skulls of the twelfth with those of the nineteenth century, we find that the capacity has increased. This single fact may, perhaps, not be sufficient to establish a rule; but it affords an index, and if supported by other facts, we shall be justified in inferring that, by progressive civilisation the cranial capacity of a race may, in the course of centuries, become gradually increased.

It might be maintained, that the variable cranial capacity presented in these observations was the result of the intermixture of various tribes which have settled in Paris. No doubt there is nowhere a more mixed population than in such a capital; but a single glance at such a population is sufficient to show that the variation pervades all ranks, and that the labouring population of Paris is nearly as much mixed as the higher classes. All the peoples of Europe furnish their quota, the losses of which are constantly supplied by fresh immigrations. As it is at the present time, so it was 600 and 1000 years ago: Celts, Germans, Slavonians, Romans, already then migrated to the Seine, and the cranial forms of the vaults of the twelfth century show that the intermixture was then the same as now.

If the table be examined with regard to races, it exhibits the remarkable fact that all European nations, without exception, have a cranial capacity of more than 1,400 cubic centimeters; whilst, of non-Europeans, only the Esquimaux and Malays exceed that measure. The former stand near the line of separation; whilst the Malay skull measured by Welcker occupies an intermediate position amongst European nations very near the Germans. Some doubts exist, however, concerning this measurement, since it differs more than 100 cubic centimeters from the measurements of Malay skulls made by Morton,—an amount of difference so large that it can scarcely be attributed to individual peculiarity alone. Welcker's Malay skull may possibly not have been that of a pure Malay, but of a cross-breed who had European blood in his veins. In the environs of the Dutch possessions in the Sunda islands, there are, probably, few Malays whose pedigrees do not exhibit the intermixture of European blood.

Setting aside these minor exceptions, we find that there is an almost regular series in the cranial capacity of such nations and races as, since historical times, have taken little or no part in civilisation. Australians, Hottentots, and Polynesians, nations in the lowest state of barbarism, commence the series; and no one can deny that the place they occupy in relation to cranial capacity and cerebral weight corresponds with the de-

gree of their intellectual capacity and civilisation. Our table, no doubt, is very imperfect and incomplete, for it neither exhibits the sex and age, nor the stature of the populations, the measurement of whose skulls is given. Still it is an index, and an important one, showing at the first glance that such investigations form a basis for the superstructure of a scientific natural history of man.

I must not omit to draw your attention to a point worthy of particular notice. According to Aitken Meigs' measurements, the cranial capacity of Negroes born in Africa is considerably more than that of the American slaves. Is this the effect of that cursed institution which degrades men to the condition of chattel, and deprives them of that liberty which alone can lead to a higher development? As slavery exercises an equally injurious influence on the master, it might perhaps be possible, by a comparative examination, to show a similar relation as regards the cranial capacity of the inhabitants of the free and of the slave states of North America. The recent tremendous butcheries may afford abundant materials for such investigations. Let the materials, then, be made use of before they find their way into the bone mills and manufactories of artificial manure.

LECTURE IV.

Structure of the Brain.—Elementary Constituents of Brain-substance.—Cerebellum.—The primitive Brain.—The Cerebrum the seat of intellectual activity.—Localisation of individual functions.—Application to Phrenology.—The Cerebral Lobes.—The Convolutions: their relation to the Intellect and the Size of the Body.—The development of the Convolutions, and their arrangement according to Gratiolet and Wagner.—Huschke's Opinions.—Comparative Investigation of various Cerebral Forms.—The Cerebral Cavities.—Dispute about them, especially in England.

Gentlemen,—Whatever opinion we may entertain regarding the intellectual functions, whether they be regarded as the manifestations of an independent soul by the intermediation of the nervous system, or as the functions of the nervous system itself and its parts, we are always reduced to the necessity of considering the brain as the organ from which the intellectual functions proceed. Every disturbance in the cerebral structure, by whatever agency it may be produced, is immediately reflected in the intellectual functions; it may even be predicted, in many instances, that laceration will be followed by certain effects, and even every change in the cerebral circulation immediately influences cerebral activity. If this be true, and no one can doubt it, for stupor and epileptic fits may be produced experimentally in any animal, we can easily imagine that the structure of the brain and its component parts stands in the most intimate relation to the development of the intellectual function, and that this mode of relation may be, though at present only approximatively, ascertained. The structure of the brain is exceedingly complicated; there is no organ in the human body which, consisting of comparatively so few elementary constituents, possesses so great a variety of parts which, by their shape, internal structure, and position,

plainly prove that they exercise different functions, though we have not yet succeeded in determining them.

On turning our attention first to the constituent elementary forms, we find in the brain of man and animals two groups of substances, a grey substance, more or less blackish or yellowish, appearing to the naked eye as a uniform mass, and a white substance apparently distinguished from the other by being composed of fibres which run in various directions. The grey substance consists of cells containing nuclei and finely granulated matter, from which issue processes subdivided into very delicate threads, which either form delicate networks or are lost in the fibres of the white substance. These nerve-cells (see fig. 28) exhibit a variety of forms which are probably connected with their respective functions, an hypothesis rendered more probable by the fact, that the grey substance no doubt origi-

Fig. 28. Multipolar Cells, with Processes in the Human Brain.

1. Cell, the process of which, *a*, becomes the cylinder-axis of the sheathed primitive fibre, *b*. 2. Two cells, *a* and *b*, connected by processes. 3. Three cells, *a*, connected by commissures, *b*, sending forth nerve fibres, *c*, 4. Multipolar cells, with much more black pigment.

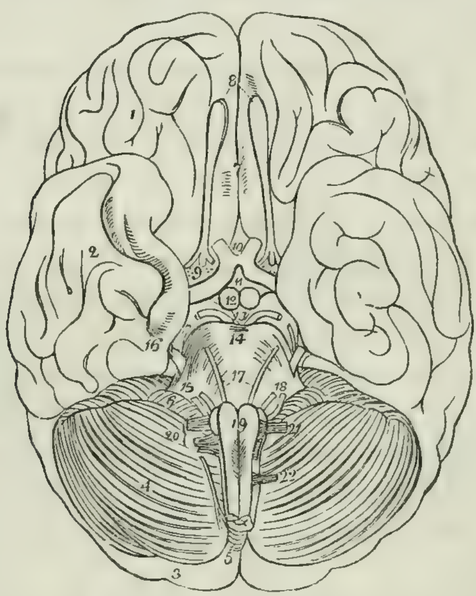
nates nervous activity, whilst the white substance acts as a conductor. All the fibres of the white substance, all the nerves entering the brain, terminate in the grey ganglia and masses scattered in the centre of the brain or on its surface. It follows, then, that in the question of the relation of cerebral structure to mental development, the grey substance and the parts chiefly composed of it, demand our special attention.

Now it does not admit of a doubt that many of the grey nuclei in the interior of the brain, are not, strictly speaking, connected with the mental functions, but only with the organs of sense. Just as in the spinal cord the grey matter has different functions, one mass presiding over sensation and another over motion, so are there in the brain grey nuclei whose relation to particular functions can be determined. In that part of the spinal cord which enters the cranium by the occipital foramen, and is then called the *medulla oblongata,* there are situated the grey nuclei which preside over the respiratory and the cardiac movements; more in front are other parts which have been experimentally proved to be related to the movements of the body and to the organs of sense. These parts are in our investigations only so far interesting in that the senses may be more developed in some races than in others. Although, however, the acuteness of the senses in some savage tribes excites our astonishment, it appears to be rather the result of training than of an original endowment, since individuals belonging to civilised races, whose calling as hunters or mariners requires constant practice, soon acquire the same acuteness of perception.

On examining a human brain at the base, we see in the centre a nearly white mass ascending through the large occipital aperture, which must be divided in order to remove the brain from the cranium. This is the *medulla oblongata,* in the interior of which we see several grey ganglia, and from the edges of which issue several cerebral nerves, as the vagus which proceeds to the heart, the lungs, and stomach. In front it is continued in a bridge-shaped structure termed the *pons Varolii,* composed of transverse fibres, and from which emerge fasciæ of white matter, which, entering the hemispheres, are

termed the *crura cerebri.* All the white parts, with their continuations, in front and above, and concealed in the cerebral mass, may be termed the *primitive brain,* inasmuch as this is the original portion which is first of all deposited during the development of the brain in the embryo. The great mass of the brain consists, as shown by comparative anatomy, of arched parts which gradually grow from the *primitive brain* and unite in the median line, so that in the interior of the brain there remains still a system of cavities, the size of which diminishes in proportion to the development of the cerebral mass.

Fig. 29. Base of the Human Brain.



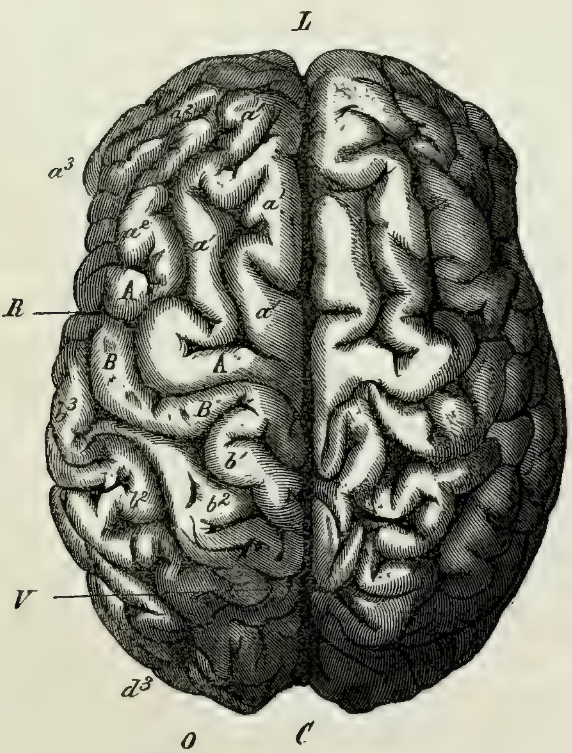
Base of the Brain. 1. Anterior lobe. 2. Middle lobe. 3. Posterior lobe of the cerebral hemisphere. 4. Hemispheres of the cerebellum. 5. Vermiform process of cerebellum. 6. Flocculus. 7. Longitudinal fissure. 8. Olfactory nerves (first pair). 9. Exit of the olfactory nerve from the brain. 10. Crossing of the optic nerves. *Chiasma nervorum opticorum* (second pair). 11. Tuber cinereum. 12. Corpora mammillaria. 13. Oculomotor (third pair). 14. Pons Varolii. 15. Crura cerebelli. 16. Trigeminal nerve (fifth pair): immediately before it, the fourth pair: N. patheticus, or trochlearis. 17. Abducens (sixth pair). 18. Facial and auditory nerve: N. facialis and N. acousticus (seventh and eighth pair). 19. Pyramidal bodies of the medulla; at their sides, outwardly, the olivary bodies. 20. Glosso-pharyngeal nerve, vagus and accessory nerves (ninth, tenth, and eleventh pair). 21. N. hypoglossus (twelfth pair). 22. First cervical nerve.

Physiological experiments have proved that it is the *primitive brain* only which possesses sensibility; that all cerebral nerves spring only from the grey ganglia it contains, and that this part is mainly connected with sensation and motion.

On further examining the base of the brain we perceive immediately above the *primitive brain* on both sides of the medulla a mass divided into lobes and laminæ. This is the cerebellum, so little developed in man and most apes, that, on being viewed from above, it seems entirely covered by the brain proper.

If a vertical section be made through the cerebellum, the medullary substance is seen covered with grey matter, producing a tree-like figure, which the old anatomists designated the

Fig. 30. The Brain of the so-called Hottentot-Venus: top view, after Gratiolet.



L. Longitudinal fissure. *R.* Rolando's fissure. *V.* Posterior transverse fissure. *F.* Frontal lobe. *P.* Parietal lobe. *O.* Posterior lobe. *T.* Temporal lobe. *Po.* Pons Varolii. *C.* Cerebellum. *V. M.* Medulla oblongata.

tree of life, *arbor vitæ.* The white fibres, called the *crura cerebelli,* connecting the cerebellum with the encephalon, are sensitive; not so the foliated parts. From all experiments hitherto made, the cerebellum seems to be chiefly connected with motion. If it be destroyed on one side only, paralytic phenomena are observed, in which the body rolls towards the opposite side; if the whole cerebellum is destroyed, the vertebral column, and consequently the whole body, loses the power of equilibrium, the animal oscillates, the walk resembles that of an intoxicated person, all the motions are irregular and without any harmony. The same facts are observed in diseases in which the cerebellum is by any cause affected. The relation of the cerebellum to the sexual functions, ascribed to it by Gall, and which has become an axiom in phrenology, has not been confirmed by experience.

It results from these facts, that the examination of the cerebellum would contribute but little to the elucidation of the questions before us, inasmuch as that part of the encephalon cannot be proved to be connected with the intellectual functions.

There remains now the brain proper, which constitutes by far the largest mass of the encephalon, covering all other parts on being viewed from above, and at once distinguished by the singular convolutions on the surface. The cerebrum is divided into two hemispheres by a process of the *dura mater* termed the *falx.* Another process of the same membrane, termed the *tentorium,* extends horizontally between the cerebrum and the cerebellum. Thus the cerebrum constitutes, as it were, a separate whole which, as comparative anatomy teaches, has overgrown and, so to say, suppressed all other cerebral parts. This overgrowth increases in the lower animals accordingly as they approach the human conformation. In the lowest vertebrates, fishes, the cerebrum is only a grey knot, situated in front of the other ganglia of the cerebral stem, and in the same line. But the cerebrum swells out like an inflated india-rubber pouch in the higher vertebrates, gradually covering the grey ganglia of the *primitive brain,* and the imperfectly arched forms of the originally separated meso-cephalon, which are known by the name of *thalami optici* and *tubercula quadrigemina;* it then

passes above the cerebellum and gradually covers it with its lower surface. A section along the course of the zygomatic arch, dividing the skull, would almost exactly coincide with the under surface of the cerebrum. The cerebellum would not be touched in such a section, as it lies in the part of the occiput covered by the insertions of the muscles of the neck.

The mass of the cerebrum is insensible ; only the crura and the tubercula quadrigemina are sensitive. In wounds of the head, when the brain is exposed, the surface may be touched or portions removed, without the manifestation of any pain. On the other hand, experiments performed on animals, especially birds, have proved that the cerebrum is manifestly the sole seat of intelligence. Pigeons may be kept alive for weeks after the removal of the hemispheres. You will find a summary of such experiments in my *Physiological Lectures* (3rd edition, p. 316). But these phenomena prove that an animal deprived of its brain continues to live, in a deep sleep as it were. The power of motion remains as well as combined muscular action to a limited extent; pain is felt, and certain movements are made to avoid it; but the animal is undoubtedly in a state of stupor, in a certain dreamy condition which admits of no consciousness. There is no combination of the sensations to manifest the feelings. The animal, as an observer remarks, might die of starvation before a well-filled trough, as the want of food does not induce the motion requisite for feeding.

The cerebrum is thus unquestionably the seat of intelligence, consciousness, and will, consequently of all intellectual activity. The white fibres contained in it serve probably for connecting the individual grey parts; for they are, like them, insensible. The question now is, whether the different intellectual functions are confined to different parts of the brain, and if so, to what parts ?

Experiments on animals furnish, in this respect, only unsatisfactory results. If the hemispheres are removed in slices, the phenomena of stupor become gradually more manifest. The removal of one entire hemisphere presents no remarkable result; whence it may be concluded that the remaining hemi-

sphere may, for a certain time at least, perform all requisite functions. All that is observed, is that the cerebral activity is sooner exhausted than in the uninjured brain, so that it is merely the quantity and not the quality of the function which is affected. Some physiologists have, not unreasonably, asserted that such an interchanging of activity of the two cerebral hemispheres may and does occur also in the living man, and that one hemisphere may, to a certain extent, go to sleep and refresh itself, whilst the other half is in a state of activity. The facts, however, upon which this assertion is based, are, as yet, insufficient for the establishment of such a theory.

Neither wounds in the head nor cerebral diseases have hitherto yielded satisfactory evidence as regards the localisation of the intellectual faculties in individual parts of the cerebrum. The question has been much discussed whether speech, or, rather, the capacity for producing articulate sounds expressing thoughts, is localised in the anterior lobes of the brain, and cases have been adduced in which a morbid condition of those parts was concomitant with loss of speech. But the fact that one hemisphere may act vicariously for the other, has been lost sight of, and also that it is but rarely that both hemispheres are equally affected. This, however, is clearly the requisite condition for estimating such a case, for that function which is destroyed by disease on one side may be preserved on the other, and, though sooner exhausted, would, for a time. be performed in its integrity. Cases are by no means rare of persons having lost a quantity of cerebral substance from one hemisphere by wounds, and who, though exhibiting no actual diminution in their intellectual functions, were compelled frequently to rest after any mental exertion, as their mental energy was sooner exhausted.

Since direct observations yield but scanty results, we may be permitted to appeal to conditions which may indirectly contribute towards the elucidation of the question. The results of such investigation certainly do not possess the same validity as those drawn from direct observation. Still, they are of some value and should not be neglected.

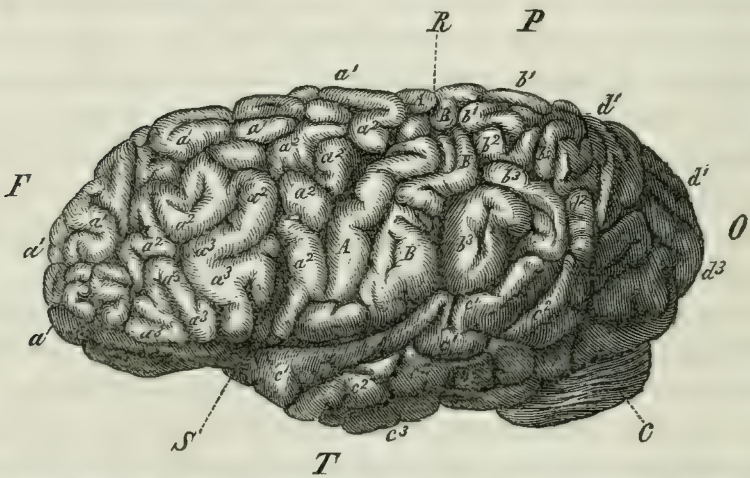
There are normal conditions in which certain parts of the

brain are less developed than others, and such conditions may be noted in the analysis of the intellectual functions. We may thus, perhaps, find that in individuals of high intellect, this or that lobe of the cerebrum is more developed than another; that the convolutions on the surface are more distinctly and differently marked in eminent persons than in persons of lower rank. Such investigations may embrace the different races of mankind, and animals also, though we must not forget that the inferences and analogies become more deceptive in proportion as we go further off from the human type. We may also call to our aid cases in which, from arrest of development, the brain has preserved the fœtal type, in consequence of which the intellectual life approaches that of the animal. A close examination of the cerebral structure of such idiots may teach us which are the special parts arrested in their development, and by comparing with the obtained data the various manifestations of intellectual activity, we may, perhaps, arrive at some conclusions as regards the functions of individual parts of the brain.

The so-called science of phrenology rests, as is well known, upon such inferences, which, however, labour under the great drawback that on the one hand the capacities are to be marked on the outer table of the skull, and, on the other hand, a localisation is claimed which in no ways corresponds either with the intellectual faculties, or with the details of the cerebral structure. However correct the fundamental principle of phrenology may be, that individual functions must correspond to individual parts of the organ, the inferences drawn from it are none the less exceedingly erroneous. On viewing the brain from above, each hemisphere appears as one mass; exhibiting, indeed, convolutions and intermediate sulci, but no actual division. It is different, however, when we view the brain from the sides or from below. In the latter case we immediately perceive in the anterior part a deep fissure which runs from the anterior margin of the cerebellum to the corresponding margin of the cerebrum, and separates two lobes which, when the brain is viewed laterally, extend far lower down than the anterior lobes. The basis of the anterior, or frontal lobes, as we shall

call them, rests upon the roof of the orbits, whilst the lower or temporal lobes fill up a deep cavity formed by the sphenoid and temporal bones in the base of the cranium, on both sides of the *sella Turcica*. Again, on viewing the human brain from below, the posterior margin of the hemisphere is seen to project beyond the cerebellum, thus forming a prolongation which is called the posterior lobe. Finally, there may, in this posterior lobe be distinguished a middle or parietal lobe which is, however, the least marked of all.

Fig. 31. Brain of the celebrated mathematician, Gauss, side view, after Wagner.



S. Sylvian fissure. *R.* Fissure of Rolando. *C.* Cerebellum. *F.* Frontal lobe. *P.* Parietal lobe. *O.* Posterior lobe. *T.* Temporal lobe of cerebrum.

On viewing the brain from the side, the deep fissure which separates the temporal from the frontal lobe is seen to divide into two branches, one of which, rising almost perpendicularly, is gradually lost in the mass of the frontal lobe; the other takes at first a horizontal direction, and is lost between the convolutions in the mass of the temporal lobe. This fissure, termed the Sylvian, is important, because, under all circumstances, it clearly indicates the division between the frontal and the parietal lobes. Viewed from above, the brain seems to consist of three parts: the anterior, the parietal, and the posterior lobes. Viewed from the side, there would be added the temporal lobe, and a small concealed lobe, called the island or the central lobe,

which is not visible externally. It may be seen by separating the margins of the Sylvian fissure, and removing parts of the parietal lobe which cover it. Though the formation of this intermediate lobe seems peculiar to the cerebral structure of man and the ape, not having, to our knowledge, been met with in other animals, it need not further occupy our attention, since the comparative anatomy of the brain, as far as races are concerned, is as yet in its infancy.

Many attempts have been made to connect the development of the several cerebral lobes with the mental qualification of individuals and races, but with scanty success. The three cranial vertebræ, namely, the frontal, temporal, and occipital, have been connected with the development of the three principal lobes, so that some authors distinguish frontal, parietal, aud occipital races, in proportion as either of these regions predominate. Some have proceeded still further, naming the races,—"Men of the day, men of the twilight, and men of the night," with the very acute remark that the forehead of man corresponded to day; but the occiput to the shady or night side of nature. Even north pole and south pole, and the point of magnetic indifference, have played their parts in these vertebral theories; from the analyses of which I must beg to be excused, as the times in which we live are not much given to such speculations as these. The actual facts obtained from investigations of the kind seem to amount to this, that the anterior or frontal lobes are intimately connected with mental development. Height, breadth, and shape of this part must be taken into special consideration in forming an estimate of intellectual capacity.

The development of the convolutions on the surface of the brain is of particular importance. As already observed, the whole surface of the cerebrum is covered with a layer of grey matter, beneath which the white substance appears. If the convolutions are broad, the white substance penetrates to their centre; if small or imperfect, they are formed wholly of grey matter. The very delicate vascular membrane which covers the brain enters into the sulci. The dura mater is stretched over the convolutions, so that the internal surface of

the cranium presents only indistinct impressions of the larger convolutions. The coarser the convolutions, and the broader the furrows which separate them, the more distinct is their impress on the internal surface of the cranium. The cast of a skull by means of a plastic mass which retains its form, is but an imperfect substitute for a view of the brain itself and its convolutions.

The convolutions contribute to increase the quantity of grey substance. Just as in the secreting glands the secreting surface is increased in size by the subdivision of the originally simple bag into tubes, so the cerebral substance, by its complicated windings, secures a surface considerably exceeding that of the internal space of the skull. Now, if it be true that the grey substance alone is the source of nervous action; if it be farther true that the superficial grey matter is intimately connected with mental activity, whilst the internal grey nuclei are rather connected with the phenomena of sensation; then it follows that the multiplicity of the convolutions is connected with the development and increase of the intellectual capacity, the substratum of which is the increased quantity of grey matter. The convolutions have been compared to the figure which would be produced by forcing a bag, possessing a larger surface than the interior of the skull, into the cranium. The comparison may be pursued, and it may be said that the more grey substance we force into a skull the greater the intellectual capacity, which would lead to the inference that an animal must be more intelligent in comparison with another in proportion as the convolutions are more complicated, and the furrows deeper.

If this principle is adopted in its crudity, a single glance at the convolutions in the brain of the mammalian series will be sufficient to overthrow it. It is true that in some of the lower mammals, *e.g.*, in the edentata and marsupials, no convolutions are observed, whilst, with few exceptions, they exist in all carnivorous animals and largely in the apes. But, on closer examination, we find that within the orders which possess convolutions their development seems to be connected with the size of the body. Now it certainly cannot be maintained that all larger animals are more intelligent than the smaller, and when it is considered

that the brains of the ass, the sheep, and the ox, all of which, in fables, are the representatives of stupidity, are more convoluted than those of the beaver, the cat, and the dog, the axiom connecting the convolutions with intelligence seems to have received a hard blow.

Happily, mathematics will assist us here. On comparing two bodies of similar form but of different size, their respective volumes vary as the cube of their diameters, whilst the proportion of the surfaces is as the square of the diameters, or, in other words, the volume of a body increases more rapidly than the surface, and this more rapidly than the diameter. Every artillerist knows well that a twelve-pounder, though thrice as heavy as a four-pounder, does not nearly possess a diameter thrice as large.

In applying this principle to the head, and specially the cranium of animals, it will be seen that in every natural group or order of mammals the head, and especially the cranial capacity, stands in a certain relation to the body, which is nearly constant in the various species. The head of the tiger and the lion bears the same proportion to the body as does that of the cat, although the size of the animals is so different. It follows hence that the volume of the cerebral mass of the tiger stands in the same proportion to the body as does that of the cat; that the surface of the internal cranial capacity is proportionately smaller in the larger animal, and that consequently in order to secure a similar surface of grey matter, it must be convoluted in the large animal, whilst it may remain smooth in the small animal. We might, therefore, infer from the above geometrical axiom, that if in two species of animals of the same size and the same normal structure, the convolutions are differently developed, this development is connected with the development of intelligence, whilst animals of unequal size are less capable of comparison with each other in proportion as their respective sizes differ. When, therefore, man, whose skull is, in proportion to the body, larger than that of the largest animals, excels all the rest in the richness and variety of the cerebral convolutions, it is manifestly in harmony with his intelligence, in which he also far excels the rest.

In instituting comparisons, they must be confined to very nearly allied groups: man can only be compared with man; ape with ape; the extension of this comparison to other animals is not admissible. On examining the order of apes, for instance, the influence of size is seen with the greatest distinctness. Thus the small leonine tamarin and the marmoset monkeys have no convolutions, the scarcely larger squirrel and tailed monkeys have but few, whilst the large anthropoid apes, the orang, chimpanzee, and gorilla, have very convoluted brains.

The old anatomists paid but little attention to the arrangement of the convolutions, specially as it was soon found that they were not symmetrical on both sides. The sinuosities were thus considered as accidental, or, as one naturalist observed, as a confused mass of intestines, so that draughtsmen represented them in anatomical plates entirely conventionally. Modern researches have, however, shown that, amidst this apparent confusion, there exists a certain regularity, a definite plan, which had not been detected for the simple reason that inquiries extended to man only, in whom this irregularity of the convolutions reached the highest degree. Naturalists were in the same position as amateurs in architecture, who are unable to make out the ground-plan on account of the overloaded ornamentation of a structure.

No sooner was attention directed to animals and the more simple phenomena analysed, than it became apparent that for every family or order there existed a special plan, as regards the arrangement of the convolutions, entirely characteristic of the orders and easily traceable in the highest as well as in the lowest forms. In the unconvoluted brain of a small lion-monkey (*Simia rosalia*, Geoffry), there is exhibited the same fundamental plan of arrangement as in the convoluted brain of the orang, and the incomparably more convoluted brain of man.

I may be allowed, perhaps, to dwell for a moment on this result of recent investigation. There is no doubt whatever that, according to the fundamental plan of his brain, man belongs to the ape. "On comparing," says Gratiolet, "a series of human and simian brains, we are immediately struck with the analogy exhibited in the cerebral forms in all these creatures.

The convoluted brain of man resembles the smooth brain of the Ouistitis in the characteristics of a rudimentary olfactory bulb; a posterior lobe, which entirely covers the cerebellum; a perfectly marked Sylvian fissure, and a posterior cornu in the lateral ventricle of the brain." [Gratiolet might have added a fifth character, the existence of a central or intermediate lobe, which occurs in all apes.]

"These characters," continues Gratiolet, "coexist only in man and the ape. The cerebellum is uncovered in all other animals; we mostly find an enormous olfactory bulb, as in the elephant; and with exception of the makis (*Lemuridæ*) no animal presents a fissure, like the Sylvian, with an enclosed central lobe.

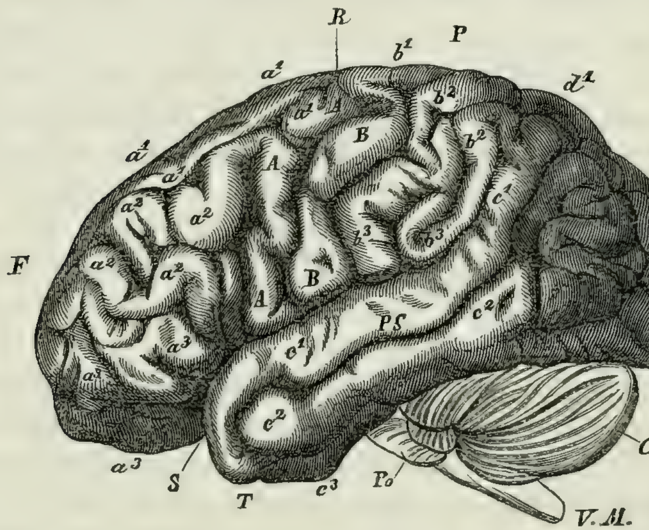
"Thus, there is a cerebral form peculiar to man and ape; and so in the cerebral convolutions, wherever they appear, there is a general unity of arrangement,—a plan, the type of which is common to all these creatures.

"This uniformity in the arrangement of the convolutions in man and ape deserves, in the highest degree, the attention of naturalists. Thus, in the makis (*Lemuridæ*), cats, dogs, bears, in short, in all families a peculiar type of convolution is found. Each of these families has its own character; and we can arrange the different species within any group by examining the convolutions."

So far Gratiolet. It seems to me to follow necessarily from these words, that it is requisite to study the convolutions more closely, since, as we shall see, their development is, no doubt, connected with that of the human type and also with intelligence. In order to proceed upon a definite basis, it is best to commence with a side view, and to start from the Sylvian fissure, which is most distinctly marked in all human and ape-brains (see fig. 31). As already observed, the Sylvian fissure divides into two branches: an anterior, nearly perpendicular; and a posterior, nearly horizontal, which, however, usually turns upwards, so that the Sylvian fissure, on the whole, takes the form of a V. Between these two branches there is thus marked off a portion which might be called the lateral middle lobe, which some authors include in the frontal, and others in the parietal lobe.

Upon these lateral central lobes, two convolutions always proceed from the point of the V upwards, extending to the longitudinal fissure of the hemispheres, where they terminate about the centre of the sagittal suture, that is to say, at the vertex. These two convolutions form at their base the covering of the

Fig. 32. Side view of the brain of the Hottentot-Venus.



The following designations apply to this as well as to all following figures of the brain in these Lectures. *F.* Frontal lobe. *P.* Parietal lobe. *O.* Posterior lobe. *T.* Temporal lobe. *Po.* Pons Varolii. *C.* Cerebellum. *V. M.* Medulla oblongata.

S. Sylvian fissure. *R.* Fissure of Rolando. *V.* Vertical transverse fissure. *L.* Longitudinal fissure. *P. S.* Parallel fissure.

A. Anterior central convolution.
B. Posterior ,, ,,
a^1 Upper fold of the convolutions of the frontal lobe.
a^2 Middle fold of the convolutions of the frontal lobe.
a^3 Lower fold of the convolutions of the frontal lobe.
b^1 Upper fold of the convolutions of the parietal lobe.
b^2 Middle fold of the convolutions of the parietal lobe.
b^3 Lower fold of the convolutions of the parietal lobe.
c^1 Upper fold of the convolutions of the temporal lobe.
c^2 Middle fold of the convolutions of the temporal lobe.
c^3 Lower fold of the convolutions of the temporal lobe.
d^1 Upper fold of the convolutions of the posterior lobe.
d^2 Middle fold of the convolutions of the posterior lobe.
d^3 Lower fold of the convolutions of the posterior lobe.

central lobe; hence they have been called the central, or intermediate, convolutions. They are separated by a deep fissure, which is easily seen in most brains, even when viewed from above.

We look upon these central convolutions as an important part of the brain; but we cannot agree with the meritorious Huschke when he says, "After what I have shown of the development of the convolutions, there can be no doubt that the point of indifference in each hemisphere is to be found in the central convolutions. Their central, indifferent signification is known by their central position (in the centre of the sagittal suture), their great size, and the depth of the central fissure which separates them, their simplicity and regularity, and finally, from their manifold connexions with their six to eight arms, which radiate to different sides, like wires bringing telegraphic messages from all parts of our mental organs to these chief convolutions, or receiving orders from thence. Here is the watershed whence the longitudinal convolutions flow north and south, forward and backwards; or the common bed into which the different branches empty themselves. With their formation in the ape, the brain enters the last stage of development until it arrives at its perfection in man, beyond which stage it cannot pass, having gained the object of its development,—a distinct point of indifference with its connecting poles. In those mammals in which these large convolutions are absent, the two poles are like the anterior and posterior halves of three superimposed horseshoes fused together. In the brain of man, they first become divided by a partition in the shape of central convolutions,—just as the heart does not reach its highest stage of development until a septum is acquired, so that red and black blood are divided from each other. The great influence of this polarity of the blood is shown by animal heat. The organism, hitherto cold-blooded, becomes in the class of birds, almost at once, warm-blooded. A similar, though as yet unknown influence must be exercised on the mechanism of nervous activity by the central convolutions. Determination, acuteness, perspicuity, greater unity of psychical life must be connected with it." Really, this is carrying polarisation a little too far. Let us return to our convolutions.

Turning from the anterior central convolutions in a forward direction, we usually find the whole frontal lobe covered with a number of convolutions, which generally stand more or less perpendicular to the anterior central convolution, that is, more or less horizontal. The convolutions nearest to the longitudinal fissure mostly proceed from the beginning of the central convolution, so that, to a certain extent, they appear as an appended lobe. We might fairly assume three stories of these complicated frontal convolutions; the ground floor (a^3) rests immediately upon the roof of the orbits, whilst the upper story (a^1) touches the top of the forehead. In poorly convoluted brains, these windings, viewed from the side, present three distinct superimposed folds; in richly convoluted brains they appear as closely intertwined plaits, rendering the separation into three stories more difficult.

The remarkable differences exhibited by brains are especially shown in these convolutions, above all, in those of the upper and middle (a^2) fold. The length of the frontal lobe varies greatly, so that the fissure of Rolando changes its place either in a forward or backward direction. The complication, also, in the shape and arrangement of these convolutions differs, not only in individuals, but even in the two hemispheres of the same brain. The younger Wagner has endeavoured to express these conditions by measuring the surface of the convolutions, and also the development of the furrows separating them. The surfaces were measured by being covered with square pieces of paper four millimeters long, thus covering sixteen square millimeters,—a method evidently much more open to errors than another in which small slips of paper are pressed into the sulci to estimate their depth.

As it may be assumed, as a general principle, that the extent of subdivision of the frontal lobe gives the measure of the degree of convolution of the whole brain, these measurements have been confined to the frontal lobe and to only a few brains; but they yield important results nevertheless. Assuming the absolute length of all the sulci of the frontal lobe of the brain of the mathematician Gauss = 100, we obtain for the brain of Fuchs, the physician, 96; for a woman of twenty-nine, about

whose intelligence nothing is said, 85; for the brain of a common day-labourer named Krebs, 73; and for the brain of an idiot who died, aged twenty-six, only 15, a diminution which, as you will observe, tallies with the hypothesis, that great development of the frontal convolutions, and consequently of the convolutions generally, is connected with the development of intelligence.

We may here observe that Wagner has also in the case of twelve brains endeavoured to ascertain the proportion between the measured convex surface, the extent of which also depends upon the development of the sulci, and the cerebral weight. As a general result it appears that the heavier the brain, the greater is the development of the surface; but that in the female sex the lesser weight, already alluded to, is compensated by a larger development of surface. Omitting from the twelve the three female brains, and having regard only to the eight male brains (the twelfth belonged to an idiot) we find a similar compensation in the male brain which, according to weight occupies the fifth, but according to surface the third place. This condition is, however, more strikingly exhibited in females, since the heaviest female brain in the whole list occupies but the eighth place, whilst, with regard to surface, it occupies the second place. In the same way the female occupying the tenth place would advance to the ninth, and the one occupying the eleventh would advance to the eighth. Subjoined is Wagner's table, in which the brains are arranged in a double series according to weight and according to surface, so as to present their relative proportions as clearly as possible:—

No.	Weight in Grammes.	Convex surface in squares of 16 square millimeters.
1. (Dirichlet)	1520	2553
2. (Fuchs)	1499	2489
3. (Gauss)	1492	2419
4. (Hermann)	1358	2406
5. Male	1340	2451
6. Male	1330	2309
7. Male	1273	2117
8. Female	1254	2498
9. (Hausmann)	1226	2065
10. Female	1223	2272
11. Female	1185	2300
12. Microcephale	300	896

No.	Convex surface in squares of 16 square millimeters.	Weight in Grammes.
1. (Dirichlet)	2553	1520
2. Female	2498	1254
3. (Fuchs)	2489	1499
4. Male	2451	1340
5. (Gauss)	2419	1492
6. (Hermann)	2406	1358
7. Male	2309	1330
8. Female	2300	1185
9. Female	2272	1223
10. Male	2117	1273
11. (Hausmann)	2065	1226
12. Microcephale	896	300

Wagner remarks, very justly, that this series is far too imperfect, and the number of measurements too small to draw from them absolutely correct inferences. The whole series nevertheless indicates that a compensation may exist, that it probably does exist in females, and that it may also extend to races which, like the Hindoos, to a certain extent exhibit the female type in their small, and not very capacious skulls.

On examining the convolutions, situated behind the central convolutions on the surface of the brain, and which form the parietal lobe, it is seen that they proceed from the posterior central convolutions. They have the appearance of notched rolls, which may also be divided into three stories, the uppermost (b) forming, as it were, only a fold of the central convolution. On viewing the brain from the top, this upper story reaches a small transverse fissure, the perpendicular posterior, or inner cerebral fissure (V), which has only a small superficial extent in man, but penetrates the more deeply into the interior. The great importance of this fissure is shown partly by its early appearance in the fœtus, immediately after the appearance of the Sylvian fissure and that of Rolando, when there is scarcely any trace of the other furrows as anfractuosities of the frontal lobe; and further, by the fact that in the ape it can be distinctly traced far over the side, separating the occipital from the parietal lobe, so that the first forms a characteristic flap which, overlapping the posterior margin of the parietal lobe, covers some convolutions which in man lie on the surface.

The second or middle convolution of the parietal lobe (b^2),

which is mostly only seen in a side view of the brain, usually joins a curve, like a bent finger, around the parallel fissure, which will be mentioned further on when speaking of the temporal region, whence Gratiolet calls it the bent convolution, *pli courbé*.

The third, or lower parietal convolution (b^3), generally appears in the shape of a triangular knob, wedged in between the branches of the horizontal arm of the Sylvian fissure, and corresponds in its position pretty nearly to the parietal eminence of the skull.

The convolutions of the temporal lobe are generally simple, and can only be distinctly seen in a side view. The superior edge of the lobe, as already observed, is bounded by the horizontal branch of the Sylvian fissure. On the lobe, parallel with this, there is a fissure—the parallel fissure (*P. S.*)—which stretches far back towards the posterior lobe and the perpendicular fissure, and separates the upper story of the temporal convolutions (c^1) from the intermediate (c^2). A second smaller furrow separates the middle story from the lower (c^3), which rests on the base of the skull. In poorly convoluted brains, these stories are scarcely at all notched on their margins; but in richly convoluted brains, the notches become secondary fissures, which, however, are rarely sufficiently deep to efface the original tripartition of the lobe.

The occipital lobe seems, in every respect, the most difficult as regards the systemisation of its convolutions. As in the human brain, its limit is only indicated by a very small perpendicular fissure, it runs without any visible separation into the parietal and temporal lobes. It is, moreover, very small, the convolutions are mostly very irregular and unsymmetrical; whilst, on the contrary, in the ape it is well defined by the great development of the perpendicular fissure.

On the margins of the lobes, Gratiolet distinguishes four so-called transition convolutions (*plis de passage*), of which the first, or upper—which Wagner calls the first convolution of the posterior lobe (d^1), adjoining the central line, behind the first parietal convolution—sends forth some folds towards the posterior lobe, which Gratiolet terms the upper story of the

convolutions of the posterior lobe. The three other transition convolutions of Gratiolet are included by Wagner in the middle story (d^2); and he also distinguishes beneath this a third, but not distinctly developed story (d^3), which rests immediately upon the cerebellum.

Gratiolet, by extending his observation to the brains of apes, has shown the special importance of these transition convolutions. In these animals, in consequence of the greater depth of the perpendicular fissure, the anterior border of the posterior lobe becomes gradually a flap which, by overlapping the parietal lobe, covers more or less the transition convolutions. This flap, which, in its inner surface, has a very characteristic structure, must be lifted back in order to see these transition convolutions in the closed fissure into which they seem to have sunk. Gratiolet has even attempted to advance this formation as a peculiar characteristic, distinguishing the simian from the human brain. He, however, omitted to take into consideration that the formation of this flap increases in the ape but very gradually; that the *plis de passage* are very inconstant, frequently differing on both sides, so that, according to another observer, if we merely keep in view the arrangements of these convolutions, the two hemispheres might belong to different species; and finally, that there are apes in which all transition convolutions lie as much on the surface as in man, and which would, therefore, have to be considered as human, if these convolutions were really indicative of the human character. These apes are, according to Gratiolet's own observations, the *Ateles* which stand next to the howling monkeys.

For the better understanding of the discussions on the distinction between man and ape, I must allude to some points regarding the minute structure of the brain which have recently gained a special importance.

As already mentioned at the beginning of this lecture, the hemispheres are developed from the brain-trunk by arches which, at first, proceed along the parietes of the skull and deposit substance internally, until both parts, the brain-trunk and the brain-vault, are so connected that only a system of cavities. remains, which cavities have received the name of ventricles.

In hydrocephalous children, the fluid is chiefly accumulated in these cavities, which thus become enormously expanded; in the normal state, these cavities are merely fissures whose lips nearly touch. On removing the hemispheres by horizontal sections, or on making a perpendicular section parallel with the central line, we soon reach the largest system of cerebral cavities, the so-called lateral ventricles, which are separated in the centre by a thin double septum, but are very symmetrically formed. In each of these singularly curved cavities there are distinguished three so-called horns; an anterior or frontal horn, which extends into the frontal lobe and overlies the *corpus striatum;* a lateral horn, which curves downwards into the temporal lobe, and exhibits in its interior a club-shaped emi-

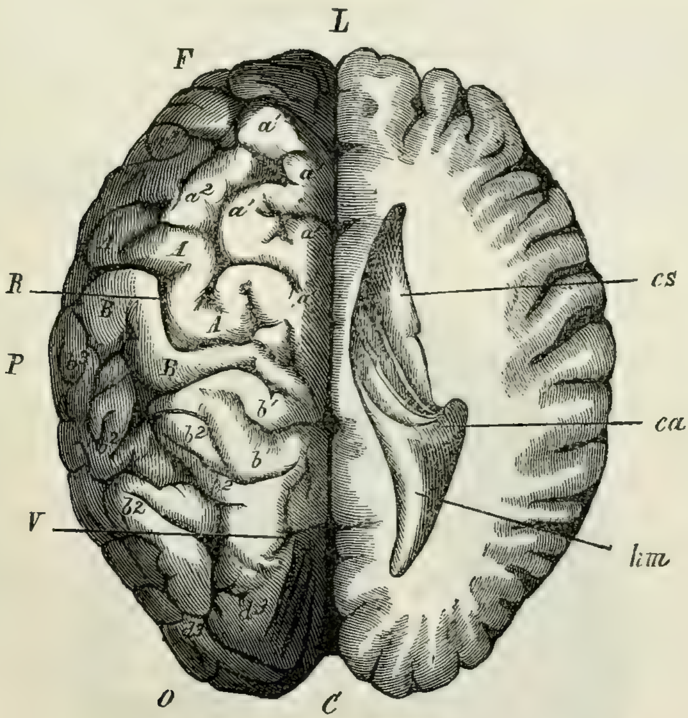


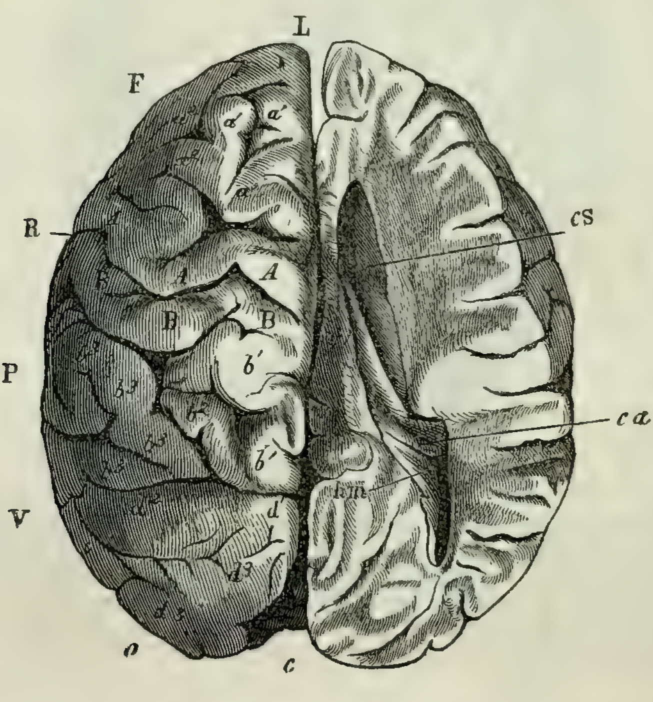
Fig. 36. Human brain viewed from above. The right hemisphere removed down to the lateral ventricles. The description of the left side is the same as in the preceding figures. On the right side, *c s* indicates *corpus striatum,* forming the floor in the anterior corner of the ventricle. *c a, Cornu ammonis,* curving into the lateral corner of the ventricle. *h m, Hippocampus minor,* forming the floor of the posterior cornu.

nence, the so-called *cornu Ammonis*; and finally, a posterior horn, which, slightly curved, enters the posterior lobe, and contains a small eminence, which has received several dozens of names, those most in use being the *little Ammon's horn,* the *Hippocampus minor,* and the *Calcar avis* (*ergot de Morand* among the French.)

On removing the hemispheres from above, the anterior and posterior horns and the hippocampus minor, and their junction with the descending cornu, as well as the choroid plexus, are plainly discerned. In vertical lateral sections, the connexion of the horns and the extension of the middle cornu can be easily followed.

I was compelled to enter into these details, because one of the greatest anatomists of modern times, Richard Owen, has maintained that the sole characteristics of the human brain are to be found in the existence of a posterior lobe, of a posterior cornu, and a hippocampus minor, and in spite of accumulated

Fig. 37. Drawing of the brain of a Chimpanzee, after Marshall; description and preparation precisely the same as in the preceding figure.



proofs to the contrary, obstinately denied the existence of these parts in the brain of the ape.

The new school of English naturalists, which seemingly does not entertain as much respect as Owen for the Established Church and its doctrines, has opposed him; and for some years past there has been at the annual meetings of the British Association a regular duel between Huxley and Owen, about which the *Times* and other journals furnish as conscientious reports as the sporting papers do about the pugilistic encounters in honour of Old England. No great results have been obtained from these duels. But in order to show which party is supported by facts, I have introduced a photograph of the brain of a chimpanzee, after Marshall, reduced to the same size as the preceding figure, and marked with the same letters. Compare them, and you will be surprised.

LECTURE V.

Examination of other parts of the body.—The Pelvis: the Extremities.—The Skin; its coloration, structure, perspiration, and hair.—The soft parts.—The Face.—Eyes, nose, mouth, lips, cheeks, ears, and chin.—Internal organs.

Gentlemen,—Whenever we find a decided and persistent variety in any essential part of an animal organism, we may be sure we shall trace its influence in the other organs. Though characters of species frequently present themselves preferentially in some particular organ; still, as a certain harmony pervades the whole structure, there will be corresponding peculiarities in other organs.

We are frequently able to trace the connexion of such changes within the animal body; but in most cases we must be content simply to acknowledge the fact of such changes in the organism, without being able to trace the causes which produced them. Thus, we may readily understand that there must be some connexion between a certain form of the cranium and that of a pelvis, since the head of the child must, at birth, pass through the pelvis; whilst, on the other hand, we certainly cannot understand why, in such or such a race, the foot should be flatter, the arm longer, and nose broader. Frequently, such distinguishing marks seem to be formed according to a leading idea, a general plan. Very often, however, all attempts to refer these phenomena to design, or to any other determining causes, are unsuccessful. At all events, variations are found in the body generally as soon as they have been proved to exist in any particular organ, and, to a certain extent, they afford a criterion of the importance of the variation to which the individual organ has been subjected. When, therefore, we have to determine what characters are of primary importance in the study of man, as an object of natural history,

we must bear in mind that, next to the skull and brain, the skeleton of the trunk and limbs demands our attention, as the relative proportion of the several regions of the body entirely depends upon the skeleton.

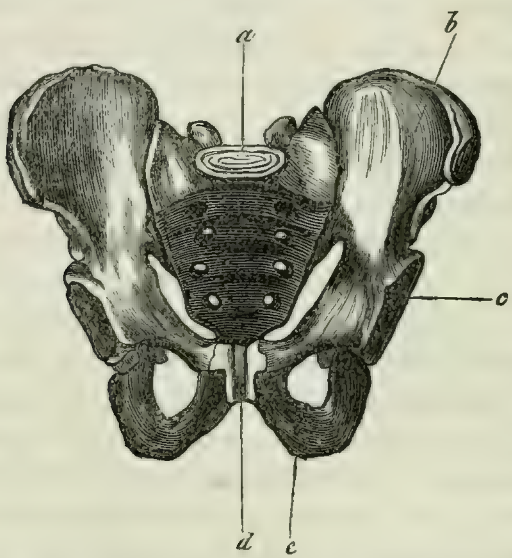
Thus, when we learn that certain tribes of South America, *e. g.* the Quichuas inhabiting the plateaux of the Andes, are distinguished by an extraordinary development of the thorax, giving to these people a peculiar aspect, there is good reason for especially remarking the structure of the vertebral column, the ribs, and the sternum, as it may be assumed that characteristic differences in this respect *may* occur in various races. This very instance, however, shows how careful we must be in at once assigning plausible causes for such peculiarities. "The Quichuas," it was said, "live upon the plateaux of the Cordilleras, in a comparatively rarefied atmosphere. They are like all mountaineers, agile, ascend mountains without much fatigue, and experience no difficulty in breathing, such as is felt in ascending Mont Blanc. It is not surprising that their chests have gradually expanded and acquired a larger volume, since they have to inspire a larger volume of rarefied air than the inhabitants of the plains, in order to obtain an equal amount of oxygen." The conclusion is, in point of fact, unobjectionable; but unfortunately, nature breaks the whole chain of reasoning by placing in the Siberian plains, along the shores of the Arctic Sea, populations whose chests are not less developed than those of the Quichuas. And thus it is with many other peculiarities attributed to climate, mode of life, and other influences; for we find, on closer examination, that peoples living under entirely different external influences present the very same peculiarities.

As already stated, the pelvis is the part which most corresponds to the skull, and by means of which we may most reasonably hope to arrive at some conclusion as regards ethnic peculiarities. It is composed of several bones grown together into one piece in the adult, but separated by sutures up to the seventh year. These bones have received the names of the iliac, ischiac, and pubes; they form a kind of ring, closed in front by fibrous cartilage, and behind, by the broad and

connected vertebræ called the os sacrum. The pelvis represents a funnel-shaped body, curving forwards, upon which, when the body is in an upright position, the intestines partially rest, and to which the thigh bones, which support the whole body, are articulated.

In the pelvis, as in the skull, the sexual differences are very evident, but they are more distinct in the former, as this part of the skeleton is so immediately connected with parturition.

Fig. 37. Normal Pelvis of a Male European, front view.



a. Sacrum. *b*. Ilium. *c*. Acetabulum. *d*. Symphysis pubis. *e*. Tuber ischii.

The female pelvis is always lighter and thinner than that of the male, and the diaphanous spots in the ilium especially are larger and apparently thinner. In the female, the transverse dimension predominates; in the male, the longitudinal. The iliac bones are more expanded in the female than in the male. The superior pelvic aperture is nearly heart-shaped in the male; in the female, it is transversely oviform. The lower aperture is, in every respect, relatively and absolutely larger in the female than in the male. The ischia, as well as the acetabula for the femur, are more widely separated; hence, the female thigh has a greater inward inclination than that of the male.

There is no doubt that, even in European nations, there exist pelvic variations, which are certainly connected with the formation of the cranium. Just as we find in cranial measurements that extreme forms occur which are normal in distinct races, as for instance, among Germans we find long heads attaining almost the dimension of the negro-head; so we find pelvic forms among Europeans approaching those of other races. There can, however, be no doubt that an exact method, as recommended for the measurement of crania, will show the existence of a normal form characteristic of each race, both for the male and the female, around which all deviations, to their furthest limits, may be grouped. Professor Weber, of Bonn, has distinguished four chief forms of the pelvis: the oval, the round, the square, and the cuneiform; and, according to him, the oval prevails among Europeans, the round among native Americans, the square among the Mongols, and the cuneiform among the black races. The distinction of these forms, and their applicability to races, may be open to objection, on the ground that sometimes only two or three specimens were examined. On studying the animal series, there can be no doubt that the shape of apertures, in which the accoucheur is especially interested, and which Professor Weber has taken as the basis of his classification, should not be taken as the sole standard of pelvic formation, but that the entire structure should be taken into account, and especially such parts as relate to the position of the young.

It is the iliac bones, and their expansion in length and breadth, which deserve especial attention in this connexion, and we should accordingly have to distinguish two forms of the pelvis, —the flat, key-shaped, and the long, cuneiform shape. On considering the pelvic sexual difference from this standpoint, it is easily seen that the normal male pelvis approaches the animal type, whilst the female pelvis most represents the human type. I shall, in the sequel, have an opportunity of showing that this resemblance to the brute is, like other characters, most marked in the cuneiform, lengthened pelvis of the negro and negress.

The form and the proportion of the *extremities* are not less

important. The characteristic peculiarity of the *genus homo* consists, as we shall show in another lecture, not merely in the existence of hands, but rather that he has *only* two hands, and *only* two feet which carry the whole body. In consequence of this, the proportion of the extremities to each other is quite different from that of the most anthropoid apes. The arms, not destined for support, but merely for work, become shorter and thinner in proportion to the legs, the bones and the muscles of which become highly developed. In common life, we are accustomed to look only at the shape of hands and feet, a well-formed hand and foot being considered the greatest ornaments of a fine figure. But the length of the arms and legs, the proportion of the upper to the forearm, and of the thigh to the leg, are of importance in distinguishing the human type from the nearest anthropoid ape, as well as in the characterisation of races and their special peculiarities.

We shall have another opportunity of explaining in what manner this resemblance to the ape, as regards hands and feet, is shown, which must be sought not merely in the length of the thin fingers, the flatness of the foot, the mobility of the long toes, and the position of the great toe, but also in the inclination of the extremities, and in their position on the ground. When the ape walks upright, which happens but rarely, he walks in a manner different from that of man, namely, upon the external edge of the sole, not upon the whole surface, an inclination which is observed in the child, and is more evident the younger the embryo is. There is thus in the child a certain resemblance to the brute; and every tendency to such a formation, every approach to a similarity between hands and feet, which might be found in human races, deserves particular attention. For we must not forget that, during the first period of the human embryo, as in all embryos, the extremities perfectly resemble each other, being of the shape of spatulated plates, which receive their development at a later period.

The colour of the skin and the hair has always been considered as an important distinctive mark of the races of mankind, because it at once strikes the eye. It is undeniable, that

the various gradations through all tints, from yellow, copper-colour, and brown, to jet black, are scattered over the globe, and that irrespective of climatic conditions. Generally speaking, brown and black peoples are met with in hot countries, fair and yellow races in the temperate zones; but there is no general rule, and the many exceptions prove that climatic conditions and the sun exercise but a secondary influence.

As regards the SKIN, its structure is not essentially different from that of mammals, and in the various races of mankind it only differs in the grouping of some structural elements, but not by the development of special tissue elements. It has been declared, absurdly enough, that the layers of the skin in the respective races should exhibit different tissue elements, if there really existed different species of mankind, in forgetfulness of the fact, that it would be exceedingly difficult to detect such fundamental differences in many different genera and orders of mammals. Let anyone try to establish the differ-

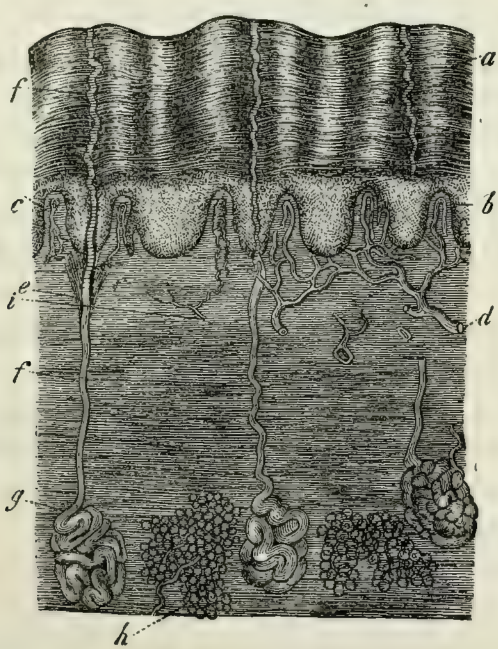


Fig. 38. Sectional view of the skin of a white man. *a*. Superficial horny layer. *b*. Rete mucosum. *c*. Papillæ of the corium; the middle with a tactile corpuscle, the rest with vascular meshes. *d*. Vessels. *e*. *f*. Efferent ducts of the sudoriferous glands. *g*. *h*. Fat. *i*. Nerves.

ence in the tissue elements of the skin of the dog and the ape, and if this be found impossible, will anyone maintain that these creatures belong to the same species? We even go further, and maintain that the skin of two known species of animals, which belong to the same genus and family, would, in the special arrangement of the tissue elements, not exhibit such great differences as are found in the white man and the negro.

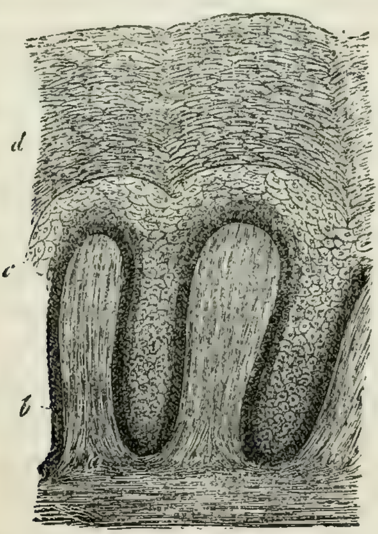
The human skin consists of two layers,—the dermis and the epidermis; the latter is again composed of two layers,—the mucous layer (rete mucosum), and the horny or scarf-skin. The cells in the mucous layer are round and nucleated, which, by development from beneath, become flattened, forming a layer lying close upon the papillary layer of the dermis. The horny, or scarf-skin, is the product of the cells of the mucous layer, which, by evaporation of their fluid contents and by attrition, become flattened, and finally form a membranous scale.

The COLOUR of the skin is mainly due to the deeper cells of the rete mucosum, the nuclei of which are brown at first, owing to the deposition of pigment corpuscles. These corpuscles increase, so that in some spots the whole cells seem to be filled with a black pigment. In the white races, there are only certain parts, the mammary gland and the scrotum, which present such a dark tint, which evidently is not caused by sunlight. We find a similar coloration in freckles, and in some morbid states the whole body may become nearly black. Some years ago, there was observed in Switzerland, during a very severe winter, a peculiar form of disease in vagrants and trampers, characterised by a negro-like colouration of the skin, not in such exposed parts as the face and the hands, but upon the abdomen and the chest.

As regards the STRUCTURE of the skin in the various races, I may quote the words of that competent observer, Kölliker, "In the negro, and other coloured races, only the epidermis is coloured, the true skin being the same as in the European; the pigment is, however, much darker and more abundant. In the negro, in whom the epidermis, as regards the arrange-

ment and size of the cells, is the same as in the European, the deepest columnar cells of the mucous layers are the darkest, forming a contrast with the lighter dermis. Then come cells which are lighter, though still brown, and which especially accumulate between the papillæ, but are also found in the top and sides of them; finally, in approaching the scarf-skin they become yellow and pale. All these cells, excepting the membranous, are coloured throughout, and especially the parts around the granules, which, in the lower cellular laminæ, are by far the blackest parts of the cells. In the negro, the scarf-skin has also a yellowish or brownish tint. I find in the yellow skin of a Malay head, in the Anatomical Collection of Würzburg, the same as in the dark-coloured scrotum of a European. Accordingly, the epidermis of the coloured races is not essentially different from that of the coloured spots in the whites, and even almost entirely agrees with the skin in particular spots (aureola).

Fig. 39. Section of the Skin from the femur of a Negro, much magnified, after Kölliker.



a. Papillæ of the corium. *b.* Lowest black-coloured cells of the rete mucosum. *c.* Lighter-coloured cells of the rete mucosum. *d.* Epidermis.

Cutaneous perspiration, like colour, has a peculiar character, which, in certain races, cannot be got rid of, even by the

greatest cleanliness. These ethnic odours must not be confounded with such as are evidently the result of alimentation, and which vary in the same races. An Italian or Provençal, eating garlic, onions, and celery will, no doubt, emit an odour different from the Norwegian or Icelander who lives on fish, blubber, and rancid butter ; still, the odour may be removed by a different mode of life. It is not so with the specific odour of the negro, which persists, wash or feed the negro as you like. It resembles entirely the odour of the musk-animal, and depends upon the peculiar secretion of the sudorific glands, which, however, in their structure, are similarly arranged as in other races, though they are larger and more numerous.

The comparative anatomy of races has, certainly, hitherto not thrown much light upon skin peculiarities, such as the peculiar velvety texture of the skin of the negro. This may, perhaps, result from the larger number of sudorific and sebaceous glands, and partly from the greater development and length of the papillæ.

Abnormal shades of colour, such as are seen in albinos, afford very little explanation. In exceptional cases, the pigment peculiar to the race is absent in some individuals belonging to it. Such conditions may, no doubt, be transmitted, though it frequently occurs that the young relapse into the colour of the original stock. Though, by inbreeding of such white individuals as mice and rabbits, and by careful exclusion of individuals relapsing to the primitive colour, a permanent variety may be formed in which the pigment is absent, we must not forget that Albinos occur in every race; and Negro-Albinos do not in the least resemble the Caucasian, but only the Caucasian-Albino, and him only, as regards colour, and in nothing else. A morbid condition, long known to Europeans before it was observed in other races, cannot possibly establish a transition from one race into another.

The HAIR fully deserves all the attention it has received, some authors, indeed, having made it the basis of a classification of mankind. Thus I. Geoffroy St. Hilaire assumes two principal groups of mankind. The straight-haired (Leiotrichi), including the white, yellow, brown, and red races; and woolly-

haired (Ulotrichi), including Negroes, Negrillos, or the black races of the South Sea, the Hottentots, and the Bushmen. The distinction is, perhaps, not sufficiently marked, and intermediate forms may be found, such, for instance, as that shown by some South Sea peoples, and called by the French *têtes en vatrouille* (mop-headed).

Be this as it may, this much is certain, that essential characters may be found in the hair. Even the distribution of this ornament differs remarkably. Whilst in the Negro and the Mongol we find scarcely a trace of hair, excepting on the head, the armpits, and the genitals, while even the down regularly found in the European is wanting, we find a small, nearly extinct tribe of the Kuril islands,—the Ainos,—whose body is so completely covered with shaggy hair, that it gave rise to the Japanese tradition, that the Aino mothers suckled young bears, which gradually became men. The distribution of the hair may thus, perhaps, also form a subordinate character of the human type. Geoffroy St. Hilaire has justly called attention to the fact, that there is no animal in which the distribution of the hair is so unequal as in man, in whom the greater part of the body is naked, or only covered with down; whilst the hair on the head, especially in females, reaches a much greater length than in any other animal. Another circumstance has been observed, that man is more hairy in front than on the back; whilst in all mammals, in harmony with their posture, the back is more hairy than the belly. The distribution of the hair, as well as its length, should, therefore, be borne in mind.

It appears, also, that there are differences, not merely in the distribution, but also in the structure of the hair.* The hair of the straight-haired human races is cylindrical; the section under the microscope appears perfectly circular, and provided with a medullary canal. Not so the hair of the Negro, which is flattened, so that its section exhibits an elongated ellipsis, in the axis of which no medullary canal is seen. It is this lateral

* See M. Pruner-Bey's most important memoir, "De la Chevelure comme caractéristique des Races Humaines," recently published in the *Mémoires de la Société d'Anthropologie de Paris,* vol. ii, p. 1, transl. in *Anthrop. Rev.,* No. iv.

compression which effects the peculiar frizzling of the hair, owing to its not taking place exactly in the direction of the longitudinal axis of the hair, but ascending in spirals, so that the hair resembles a spiral spring, which always returns to its shape when drawn out.

The arrangement of the SOFT PARTS is not less necessary for the characterisation of the various human races. The distribution of the muscular apparatus upon the trunk and the limbs becomes very important in relation to the corresponding arrangement in the ape. The pendulous abdomen of some of the lower races, among whom a mature man resembles, in this respect, a Caucasian woman who has had a large family, shows an approximation to the ape, as do also the want of calves, the flatness of the thighs, the pointed form of the buttocks, and the leanness of the upper arm, observed in other races. The observer must, no doubt, be careful not to assume, as original race differences, changes produced by famine, etc. The Australians, Bushmen, and some less known American tribes, have a severe struggle for existence. Their increase is impossible on account of privations, and if subject to further injurious influences, the tribe becomes extinct. In such cases we find some characters, such as deficiency of muscle, to be the consequence of the condition under which the tribe has lived for many years, and we must be careful how we infer an original character from them. But when, as in many Negro peoples, we find that food is possessed in abundance, the muscular apparatus may very properly be included in the series of distinctive characters.

The FEATURES depend less on external influences. Even the general form of the face, and the proportions of its component parts, are frequently characteristic to an extraordinary degree. There are faces of a perfect oval form, the chin representing the pointed, and the forehead the obtuse, end of an egg There are some which present the form of an elongate ellipsis; while others present the aspect of a pentagon, or of a pyramid, or a square with round corners, the angles being formed by the cheekbones. We then come to the proportions of the several parts of the face. In the well-formed European, the

three segments, the frontal, the nasal, and the lower part of the face, are nearly all of equal breadth, the forehead predominating in the European. In other races the proportions vary; sometimes it is the nasal segment, sometimes the lower facial segment which, receding or advancing, stamps a peculiar character upon the face.

Just as the form of the orbits in the skull, so in the face, the form, the size, and the position of the eye, and its appendages, must be taken into consideration. As is well known, some peoples, as the Chinese and Japanese, are distinguished by the peculiarity of the aperture of the eye, the outer angle of which has an oblique, upward direction. This character is, by the artists of these peoples, exaggerated for the purpose, as it seems, of exhibiting its beauty, as contrasted with the red-haired barbarians. We should also pay attention to the development of the third eyelid, which, in the white races, is only indicated by the small fold in the internal angle of the eye. This third eyelid is generally considerably larger in mammals, though never developed into a perfect nictitating membrane, as in birds. There is no doubt that in some tribes, especially among Negroes and Australians, the nictitating membrane is not smaller than in apes, so that these peoples exhibit an approach to the animal type. In unmixed tribes, the size of the cornea in proportion to the apple of the eye, as well as the colour of the iris, are as characteristic as in the various species of animals; whilst intermixture produces essential differences in this respect, as well as regards the colour of the hair.

The size and shape of the NOSE equally presents, in unmixed nations, characteristic peculiarities. In some cases, the nose is prominent, straight, or curved; in some, thick, bulbous; in others, broad, flat, like that of the ape. The position of the nostrils varies accordingly. On viewing a Caucasian face from below, the nostrils form two nearly rectangular triangles, the hypotenuses of which are turned outwards; whilst the septum of the nose forms a perpendicular line common to the two triangles. On taking a similar view of the Negro face, the nostrils present only a transverse aperture, or the

figure of a horizontal eight united in the middle by the nasal septum. Now, it is just these original ethnic forms of the nose which seem in a high degree permanent, and likely to recur in intermixtures. Thus, in all American mongrels, the sharp-backed, thin, projecting eagle nose of the redskins is one of those characters which persist longest, and indicate the source of the intermixture.

The form and size of the MOUTH, the shape of the LIPS, and the CHEEKS, are features not less characteristic. There are peoples with such wide mouths that the cheeks seem to split up to the ears; there are others with lips so puffed up that the red parts nearly reach the nose, and seem to cover the chin. It may be objected that such forms are sometimes developed among ourselves; but here again I must observe, that such deviations do certainly occur among mixed populations, whilst in pure races the form of the soft parts is nearly the same in all individuals; hence, they resemble each other more than individuals of mixed and civilised races.

The projection or recession of the CHIN, as well as the form of this projection, is not less worthy of our attention, being one of the essential characters of human nature. The broad square chin of many nomades in the interior of Asia is in striking contrast to the pointed chin of the Semitics, and the apish chin of the Negro, which has hardly any projection at all.

Finally, we must not neglect the EARS. The remarkably small, thick, projecting and gristly ear of the Negro presents a striking contrast to the large, broad, but thin ear of the Tatars and Calmucks, which presents some resemblance to the large ear of the Chimpanzee.

Not much can be said with regard to the INTERNAL ORGANS, the peculiarities of which are less known than those of the external form. Still, there are some indications, chiefly referring to the Negro, which we shall consider in the sequel, showing that here, also, differences exist as great as those observed in different species of mammals belonging to the same genus.

I cannot quit this subject without drawing your attention to the great difficulties attending the description of the external

peculiarities of living men. Dress, habits, and manners, are apt to produce ideas which do not correspond to the reality, or are evidently exaggerated. It has been said that we cannot imagine a Turk without a shaven head, or a Chinese without his pigtail and wide breeches. This circumstance shows the necessity of studying the comparative natural history of mankind in the originals, and not from hearsay.

I must also impress upon you, that the more mixed the races are which occupy our attention, the more numerous must be our observations, and the more searching our inquiry into particulars. A hundredfold greater exertions, more numerous measurements, drawings and photographs are required, to extract from the great hotch-potch of European intermixtures the original types, than are necessary to point out the peculiarities in pure types. Whilst it is the individual character which strikes us at once in the European, the sight of a Bashkir impresses us with the general race type; and whilst among the latter the unpractised eye cannot easily distinguish one individual from another, we are in the European frequently doubtful as to the stock to which he belongs. I recollect how my grandmother amused us children by her stories of the war of liberation, and her description of the faces of our liberators, which came from the eastern steppes, under the Russian banner, which, by the way, they left us as the banner of German politics, whilst they carried back the spoils of the citizens into their steppes. She told us how they rushed into the kitchen, how they opened their wide mouths garnished with tremendous teeth, and winked with their obliquely set eyes. Each appeared a wolf, and only a wolf,—no individuality was distinguishable; they seemed to be all formed after the same model,—Bashkirs and Calmucks,—ancient, very ancient, nobility of pure and unmixed stock from the Asiatic cradle of mankind!

LECTURE VI.

Comparison of the Structure of Man with that of the Ape.—Differences.—Defencelessness.—Erect position.—Equilibrium of the Skull.—Free mobility of the Anterior Extremities.—Formation of the Pelvis.—Proportions of several parts of the body.—Proportion of the Cranium to the Face.—Development of the Jaws.—Proportion of the Cranial Angles.—Cubic capacity of the skulls of Men, Idiots, and Apes.—Herr Bischoff and the Idiots.—Nose, intermaxillary Bone, and Teeth.—Signification of the Diastemata.—Structure of the Pelvis.—Proportions of the Limbs.—Hands and Feet.—Differences in the Form of the Brain.—Dispute between Owen and Huxley.—Researches of Gratiolet and Wagner.—Relations of the Transition Convolutions and the Operculum.—Development of the Brain.—Form of the Brain in Microcephali.

Gentlemen,—In the preceding lectures, I have directed your attention to the method of investigation, and to certain points which must be particularly attended to in researches regarding the races of mankind. With few exceptions, I have confined my remarks to man, and have only glanced at the relation of the superior animals standing next to man, in order that we might more easily succeed in solving the problems presented to us.

But however desirable it might be, in some respects, to confine our attention to man; it is, on the other hand, impossible to neglect the relations in which man stands to the brute creation. This is the more necessary, as it is our object to show that such relations do exist, and that they are sufficiently strong to connect man indissolubly with the animal world, of which he is only the last and highest development, and not the separate product of a special creative act. By examining, therefore, the relation of man to the ape, by pointing out the similitudes which establish the closest analogy to this highest type of mammals, by showing the differences which, on scien-

tific principles, induce us to separate the human type from the ape type, not merely as a genus, but as a Family and Order, or, at least, sub-Order, we may advance a step towards the knowledge of our own nature, and acquire a basis for further researches. We shall preferentially keep to those differences which, rightly or wrongly, have been set up, leaving the features of resemblance, which certainly predominate, in abeyance for the present. We shall give weight to the anatomical characters above everything else. At philosophical and religious arguments, by which even naturalists sometimes endeavour to support their systems, we shall only cast occasional glances. It will not concern us much that Schopenhauer places the difference between man and ape in the Will, whilst Bischoff, of Munich, places it in self-consciousness.

Let us first examine the human structure in general. Every animal, we are told, has some weapon of defence or offence; man alone has none. "The intelligent observer," so it is asserted, "cannot fail to perceive that it is in reference to this point that the Creator has implanted in the human organism the germ of, and necessity for, the development of the faculties with which it is endowed."

It is true, man has no horns; his canine teeth are neither large nor formidable, neither are his nails claws. But, on the other hand, is the axiom generally true, that all animals are armed? In what respect are the weapons of the chimpanzee superior to those of man? Its canine teeth are scarcely longer, and certainly not intended for attack; its nails are just as flat; its forehead just as devoid of horns. When attacked, the animal acts like an unarmed man; it scratches, bites, strikes, throws stones or branches of trees, and finally runs away if it cannot save itself in any other way. Hundreds of other species of apes are in the same condition as the chimpanzee. Has this defencelessness of the chimpanzee caused him to become one of the lords of the creation? Are the faculties of the hornless sheep or the doe more developed because of their defenceless state? or shall we say that the sheep has a weapon, because it butts with its hard skull? and if this were so, does not the Negro use his skull, of ivory-like hard-

ness, in the same manner? Does he not knock down his adversary by striking him in the breast with his head? and do not two Negroes, when fighting, butt one another like contending rams? We cannot, therefore, accept the exceptional state of man in this respect, nor the inference drawn from it, though it has been assumed by ancient authors. The older the opinion, the older is the error.

There is, however, an exceptional condition, an essential attribute of human nature, and one which distinguishes the bimana from all other mammals, namely, the *upright posture.* The main characters of the human structure are in harmony with this position; they partly stand to each other in the relation of cause and effect. It is true that an upright posture cannot be said to be entirely confined to man to the exclusion of the rest of the animal kingdom; for among birds there are some, as the penguin and the auk, which stand and walk as uprightly as man. Here, however, there are other structural relations which occasion this posture. Man is absolutely distinguished from the animals most closely related to him structurally, the apes, by the erect posture, which is only assumed by the latter transiently, or in consequence of training.

The proportionally large skull, with its contents, rests *in equilibrio* on the points of support afforded by the vertebral column. The arrangement exhibited by the articulating surfaces of the so-called atlas, and of the second cervical vertebra, the axis, almost seems to have been the model for such mechanical contrivances as are used to secure the horizontal position of the mariner's compass or of ship lamps. Two articular surfaces on the upper side of a ring, *i. e.*, the first cervical vertebra, the atlas, as anatomists call it,—transverse articular surfaces on the under side of the same ring,—a projection serving as an axis on which the ring turns—the head is balanced on this mechanism, and has its motions free in all directions. The muscles, tendons, and ligaments are so attached, that the slightest effort is sufficient for the re-establishment of the disturbed equilibrium. When we find in the animal world a heavy head on the top of the spinal column, we also find a development of the spinous processes of the cervical

vertebræ, to which is attached the *ligamentum nuchæ* inserted in the occiput. A well-proportioned skull will be *in equilibrio* when supported on the two articular surfaces at the base near the occipital foramen; if the jaws project forwards, as in the prognathous negroes, the occiput becomes elongated in order to establish the equilibrium. Not so in the mammalia. In the natural position of most of these, the axis of the vertebral column runs parallel with the horizontal plane of the pelvis; whilst in man it forms with it nearly a right angle. The axis of the head, again, forms in mammals a right or an obtuse angle with the axis of the vertebral column; its direction is perpendicular, and the long jaws form the arm of a lever which draws the head still more downwards and forwards. The elastic ligamentum nuchæ is then developed as a counterpoise; and even in the most anthropoid apes, the orang and chimpanzee, but especially in the formidable gorilla, we find the cervical spines prominent, and provided with powerful muscles and ligaments. With all this, the position of the occipital foramen itself is closely connected, as we shall see in the comparative structure of the skull.

The relations of the thorax and pelvis may also be explained by the erect posture. The transverse diameter of the human chest is greater than the antero-posterior, the reverse of the proportion in mammals. The chest of man is flattened in front and behind, and arched on the sides; that of the mammal is laterally compressed, with a cuneiform inclination towards the sternum and the backbone. The arms and hands of man hang down by the sides freely, and are thus unconfined in their movements, and adapted to the manifold purposes which their not being used to aid the support of the body, enables them to subserve. For in all mammals, in which the hand is not transformed into an instrument for flying or into a fin, the anterior limb always serves as a support in locomotion. This is the case even in the most anthropoid apes.

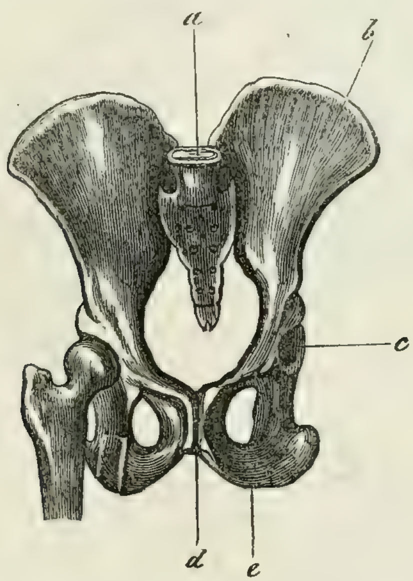
In the ape the anterior hand as well as the posterior is used for climbing; and when the animal moves on the ground, it supports itself on the closed fist, when, from the length of the arms, it assumes a more or less half erect position. But every-

where in the animal world, as Milne-Edwards has most convincingly shewn, the division of labour is an index of perfection. An animal which has four limbs apparently destined for the same end, as is the case with the horse and the sheep, is in this respect inferior to the animal in which the anterior limb is at the same time a prehensile organ, as in the squirrel and the beaver. The ape, whose four limbs are provided with hands, stands in this respect a step below man, in whom the legs are exclusively adapted for locomotion, and the hands exclusively prehensile organs. The more special the function of an organ, the more perfect it is: the greater the number of purposes an organ has to subserve in the animal economy, the more imperfectly will they be performed. Hence, though the hand is in every respect a more perfect organ than the merely locomotive foot, the multiplication of hands must still be considered a mark of defective organisation, since each of these hands is at the same time a locomotive and prehensile organ, whilst the restriction of both these functions to two different sets of organs is a step towards perfection.

The breadth of the hips, and the pelvis, which forms their osseous support, is still more connected with erect stature than the width of the thorax. The bowels suspended in the thoracic and abdominal cavities press downwards. The pressure of the thoracic contents is partially neutralised by the diaphragm which separates the cavity of the chest from that of the abdomen; but the whole weight of the intestines, including liver and spleen, rests upon the pelvis. This latter expands like a dish; the iliac bones become broad and flat, excavated above and arched downwards and outwards; so that the name "pelvis," or basin, is perhaps one of the best chosen in anatomy. In animals, on the other hand, the pelvis bears but little of the weight of the bowels; and just that part which does bear it, namely the symphysis pubis, is in man least concerned in this respect. The weight rests, in the animal, upon the central line of the chest and the belly, the pelvis chiefly serving as the fulcrum of the hind legs. Hence the pelvis presents no extended surfaces, but becomes long and narrow; the parietal parts resemble the shoulder-blades, which serve as supports to

the fore legs. The greater the mass which the pelvis has to support, the broader and more dish-shaped does it become.

Fig. 40. Pelvis of a Male Chimpanzee, reduced to the same length as the human pelvis, fig. 37. The description is the same.



Thus we see in the female, besides its relation to parturition, that the pelvis is also large, because periodically it has to bear, in addition, the contents of the gravid uterus. To the width of the pelvis must be added the powerful muscles of the haunches and the buttocks, which proceed from the pelvis to the thighs. No animal presents such a rotundity and fulness of the buttocks; no ape such a cylindrical, gradually diminishing thigh; and we are justified in saying that man only possesses thighs. The muscles of the leg are in man so accumulated as to form a calf, whilst they are in the ape more equally distributed; still transitions are not wanting, since one of the greatest characteristics of the Negro consists in his calfless leg.

The proportions of individual parts of the body, and specially of the limbs, are not less worthy of notice. The arm of man is proportionally shorter, the leg longer and stronger, than in the ape. If a man is placed in the posture of a quadruped, he must stretch out his arms; but he must bend his legs if he is

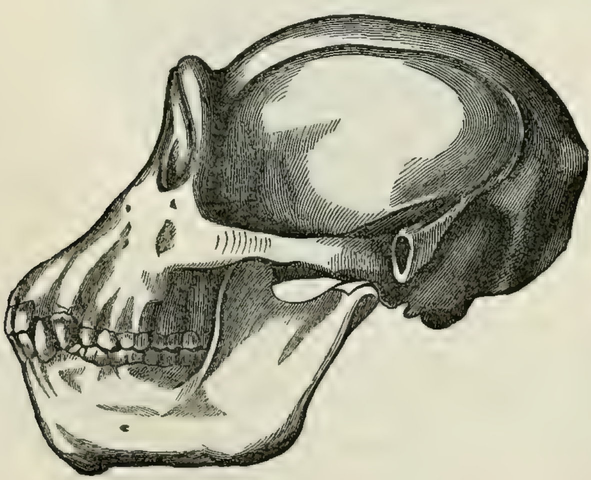
to bring his vertebral column into a horizontal position parallel with the ground. In the ape both limbs are either of equal length, or the leg is shorter than the arm, which in some species reaches an extraordinary length. Thus the orang shews his affinity to the gibbon (*Hylobates*), a native of the same country, by the length of the arms, which reach down to the ankle; whilst in the chimpanzee they reach only the middle of the leg, in the gorilla the knee, and in man only the middle of the thigh. On the other hand, the articular surfaces of the arm, specially at the wrist, are so arranged that a much greater mobility forwards and backwards is effected. Nevertheless, the long arms as well as the legs of the ape, though they are deficient in muscular rotundity, possess much greater strength than those of man: thus it is a gymnastic feat for a man to hang for a considerable time, or to draw himself up by the arm; but with the ape this is an ordinary and by no means fatiguing posture. In the quadruped every limb shares almost in the same degree the burden of the body. Only leaping animals, such as hares and kangaroos, resemble man in some degree in the length and strength of the legs, even much excelling him, as the shortened fore legs are out of proportion to the colossal hind legs. Here, however, a number of organic conditions cooperate to prevent any closer comparison. The great development of the tail in leaping animals, as a sort of balancing pole; the development of the foot; the simple, long, metatarsal bones and toes,—exhibit a fundamentally different type which cannot be compared with that of man. Thus man possesses, as contrasted with the ape, a distinctive character in the strength, rotundity, and length, of the leg; especially of the thighs, which in most animals are considerably shortened in proportion to the leg.

On proceeding to a closer examination of the separate parts, the head with its component parts, cranium, and face, first fixes our attention. I have already, in a preceding lecture, pointed out that in man super-position predominates; while in the ape a juxta-position, or rather a position of one part in front of the other, prevails; that the (anatomical) face included between the eyebrows and the chin is only a small appendage of the human cranium, which expands in every direction, above the

Fig. 41. Side view of the Skull of an ancient Helvetian.

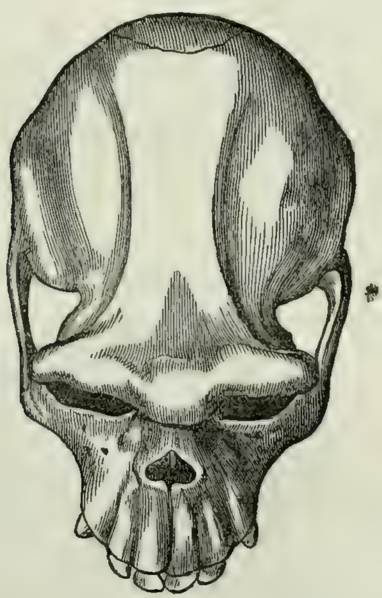
eyebrows as forehead, on the sides as temples, above the occipital foramen as neck, in order to obtain space for the disproportionately large brain; whilst in the ape the cerebral space is more receding, the forehead is flattened, and the occipital foramen placed further back; so that in the lowest apes it reaches the limit of the base, and in the other animals is placed at the posterior surface of the skull.

Fig. 42. Side view of the Skull of an aged Chimpanzee.



Camper's facial angle varies in man from 70 degrees to 85 degrees; and there is probably no instance of a normal human skull known where it is as low as 64 degrees. In the Negro skull here depicted the angle amounts to 67 degrees; and, according to Geoffroy St. Hilaire, the skulls of the Makoias or Namakas, a South African tribe, sent to the Paris Museum by Delalande, have a facial angle of only 64 degrees; whilst it decreases in the adult chimpanzee to 35 degrees, in the orang to 30 degrees; though when these animals are young, and the jaws undeveloped, it frequently reaches 60 degrees. On the other hand a small American ape, the saimiri (*callithrix sciurea*), as regards organisation, is far more remote from man, but very human-like in behaviour in some respects (it weeps readily, for instance); has a facial angle of 65 to 66 degrees; so that it completely fills up the gap. Equally decided are the differences

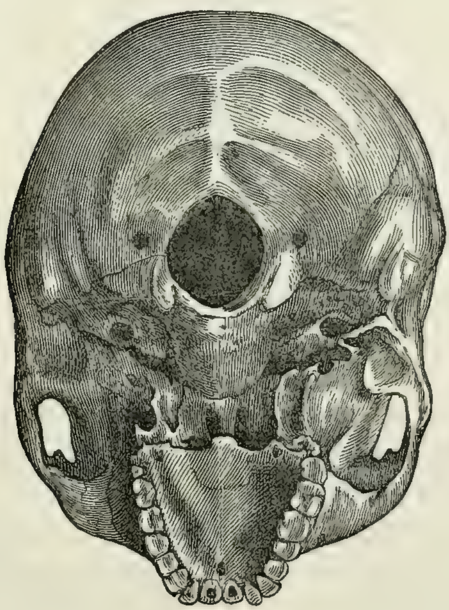
Fig. 43. Skull of an aged Chimpanzee, top view.



observed in the development of the jaws. The temporal muscles which raise the jaws must be stronger in the apes, inasmuch as they have to move a longer lever, independently of the greater development of the jaws in width. Hence the

temporal fossæ are so deep in the ape-skull that it seems as if the skull had been grasped from above, behind the eyebrows, and forcibly compressed : hence the zygomatic arches are more distant, and the temporal ridges, to which are attached the fibres of the masseter muscles, rise more towards the vertex and farther behind the aperture of the ear. In some anthropoid apes, as in the gorilla and orang, there is observed, in advanced age, simultaneously with the increased size of the jaws, a prominent ridge, a sort of crest, on the cranium, presenting a larger surface for the attachment of the masseter muscles ; so that in these apes the whole skull is covered with muscles, while in man it is in most parts only covered by the scalp.

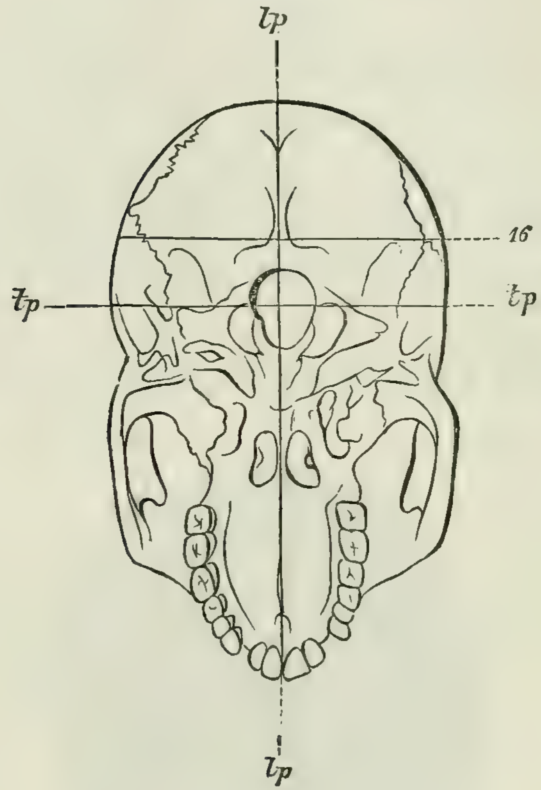
Fig. 44. Base of the Skull of an ancient Helvetian.



Closely connected with the development of the jaws, is the position of the zygomatic arches and of the occipital foramen ; and this is at once observed in the examination of the base of the skull. In human skulls the zygomatic arch always lies in the anterior half of the longitudinal diameter. The external

aperture of the ear, where it terminates, is situated, even in the Negro, in the middle of the longitudinal diameter, and even

Fig. 45. Base of a Kaffir Skull.

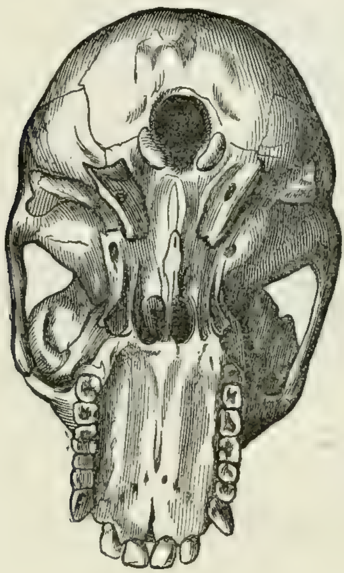


more forward in the higher races; but in the anthropoid apes the aperture is situated farther back, and the distance to the end of the jaw is greater than to the hindmost occipital prominence; while the zygomatic arch reaches the posterior half of the longitudinal diameter, and frequently extends to the last third of the length of the skull. The large occipital foramen is also thrown back. In the ape it is situated in the posterior third of the skull; in man it lies usually in the centre, or even a little forward,—a difference to which Daubenton long since drew attention, and which has been fully confirmed by subsequent researches.

We must here direct your attention to the relations of the

angles which can be measured on the skull when bisected longitudinally, and which, as already explained in a previous lec-

Fig. 46. Base of a Skull of an old Chimpanzee.



ture, are of great importance for estimating the proportions of the cranium to the face and jaws. The sella, or sphenoid angle, is, as shown by Welcker, always smaller; and consequently the base of the cranium more bent, in man than in the ape, though transitions do exist.

The nasal angle increases with the sphenoid angle, as may be seen in the following table taken from Welcker:

Cranium.	Nasal Angle.	Sphenoid Angle.
Mean of 30 male Germans	66·2	134
Idiot aged 44 (Halle Collection)	67·9	138
Three Negroes	67·6	138
Idiot aged 31 (Göttingen)	80	145
Chimpanzee	—	149
Three other Negroes	74·9	150
Young Orang	98	155
Swine Ape (Inuus nemestrinus)	102	170
Old Orang	104	174
Roll Ape (*Cebus apella*)	103	180

With the extension of the cranial basis, which also obtains in the gorilla,—in which, according to Owen, the sella turcica is less depressed than in the chimpanzee,—is undoubtedly connected the internal capacity of the skull. The occipital foramen, as well as the minor apertures through which the cranial nerves pass, are all larger in proportion to the cranial space than in man; a natural consequence of the greater size of the spinal cord and the nerves in proportion to the cerebral hemispheres.

The internal cranial capacity and certain of the chief measurements are, according to Owen, as follow:

	Englishmen.	Malay.	Negroes	Australians.	Gorilla.	Orang.	Chimpanzee.
	In. lines			In. lines	In. lines	In. lines	
Length of Skull......	7. 4.			8. 0.	11. 10.	9. 0.	
Length of cerebral space..................	6. 6.			6. 3.	5. 1.	4. 3.	
Height of cerebral space..................	5. 6.			5.	3. 3.	3. 5.	
Contents of cerebral space in cubic inches	96	86	82	75	30	28	28

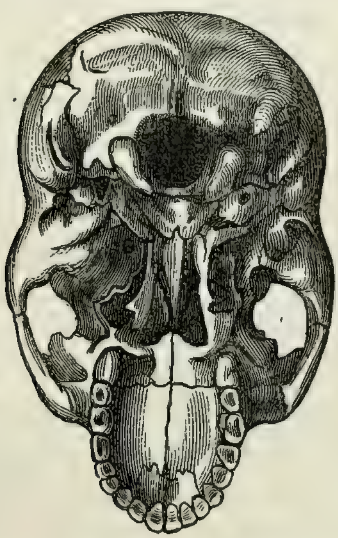
Despite the equality in height which may exist between the gorilla and the Australian, the cranial capacity is one and a half times larger in the latter than in the former; a proportion so much the more favourable for the Austral Negro, as in the gorilla the legs are proportionally shorter, and consequently the trunk larger and more powerful. The limits may, however, be brought closer together; for the smallest human skull, not idiotic, measured by Morton, had a capacity of 63 cubic inches, whilst the largest gorilla cranium recently measured possesses only a capacity of 34½ cubic inches.

These measurements afford, moreover, an important insight into the relative proportions of the skeletons of the head and face. If we assume the entire length of the skull = 100, and then express the proportion in which the length of the cerebral space, that is to say, of the brain itself, stands to the length of the skull, we obtain the following numbers: Europeans = 89·1; Austral Negroes = 78·7; orang = 47·7; gorilla = 45·9; whence

we obtain for the proportion of the facial skeleton the following numbers: Europeans = 10·9; Austral Negroes = 21·3; orang = 52·3; gorilla = 54·1.

Fig. 47. Skull of an Idiot, after Owen, side view.

Fig. 48. Skull of an Idiot, after Owen, base view.



Thus from every point of view there always presents itself a great interval between man and ape in the conformation of the skull, occasioned by the relative proportion of the cranial and

facial parts. As we have seen, the length of the cerebral space extends in no anthropoid ape to one half of the whole length of the head; whilst in man, even in the lowest races, the length of the facial part constitutes only an unimportant fraction, which in the Australian does not amount to a quarter of the whole length. There are, no doubt, Negro heads in which the quarter is reached, and even slightly exceeded, inasmuch as the genuine Negro has a proportionately much longer and narrower skull than the Austral Negro; but the gap can only be filled up by those unfortunate creatures born as idiots, and known by the name of *microcephali*,—their defective formation of brain and cranium not being produced, as in cretins, by disease after birth, but by an original arrest of cerebral development. In such creatures, sometimes the offspring of normal parents, and of which the so-called Aztec children are instances, we find all the intermediate proportions between the cerebral and the facial skull that can be imagined.

In mentioning idiots, I come into collision with a mighty authority, not unlike the fragile clay pot with the iron kettle. Addressing his Munich audience, Prof. Bischoff says: "Comparisons have been made with diseased and degenerate men as they appear in the shape of microcephali, idiots, and cretins. The error thus committed is palpable, since these unfortunates are not men *at all*, but monstrosities; the saddest thing about them being that they possess human shape without being men." We should like to ask where man ends and monstrosity begins? Is a man with a cleft iris no man, but only a monstrosity? Is that citizen of Hamburg who, some years since, travelled about to exhibit his cleft sternum, through which the heart could be felt, a man, or only a monstrosity? Is the unfortunate being who is born without arms, and has to paint with his feet; who converses with you in your own language, and is a cheerful, intelligent, and witty companion (we have known such cases,—and the instance of Ducornet, who, though deficient in hands, became a painter, is well known), is he no man because he has only stumps? And if all these individuals are men, which no person can doubt, why should individuals with malformed brains (as much an organ of the body as the eye, sternum, or limb) not be men?

No doubt we ought not to compare abnormal with normal conditions, still we may often avail ourselves of them for explanation and elucidation; and it is only in this sense that I mention them here, as being, to a certain extent, a key to the process through which the human skull rises from the ape to the human type.

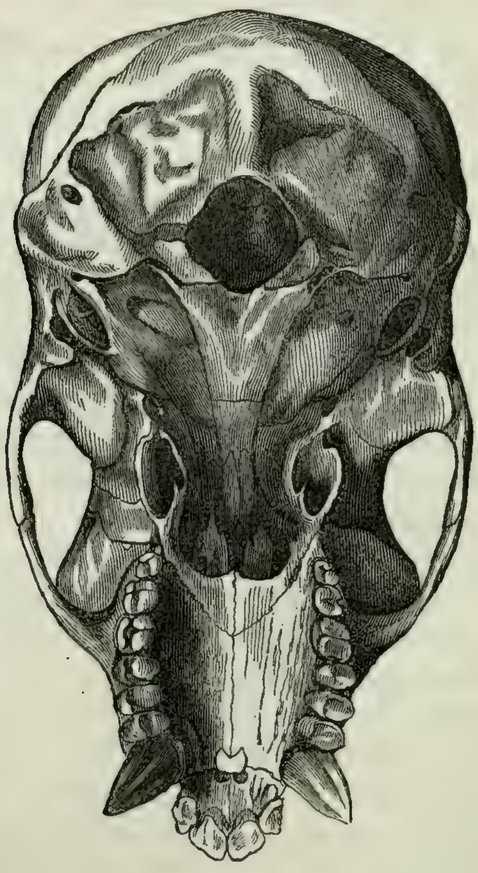
Let us return to our subject. On examining the facial portion of skulls we find a great difference between man and ape in the conformation of the nasal bones and the mode of their connexion. In the ape the nasal bones are broad, depressed, mostly grown together in the middle; the nasal apertures consequently oblique, or in form of a horizontal 8, and, viewed from below, parallel with the apertures of the eyes. But in the gorilla the middle of the nasal suture rises in the form of a little crest; and in the Negro the nose is so depressed that the difference between the two formations is scarcely perceptible. It is remarkable that there is also an analogy between the Austral Negro and the gorilla as regards the internal nasal cavities,—the frontal sinuses which are met with in all other races, causing the projection of the region between the eyebrows. These cavities, which are so enormously developed in the elephant, are absent both in the Australian and the gorilla, though they exist in the other anthropoid apes.

The incisors are inserted, in all mammals which have them, in a special bone, the intermaxillary, which is generally recognisable throughout life, and remains separated by sutures from those parts of the maxillary bones which contain the canine teeth and the molars. The elements from which the intermaxillary is developed exist also in man, and are plainly perceptible in the fœtus. But it soon becomes confluent with the other bones, so that even in the new-born infant the sutures are generally obliterated, and the union with the upper jaw complete.

At the beginning of this century, when the history of development had as yet made little progress, the absence of the intermaxillary was considered as a specific human character; and Goethe, assisted by that excellent anatomist, Loder of Jena, took great trouble to point out the error. At present it is only the early union which can be cited; but even this has its

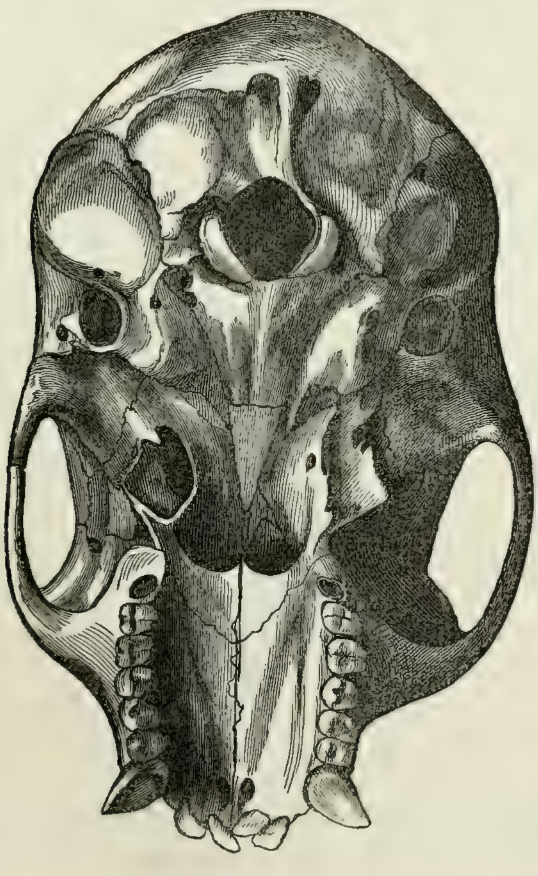
degrees. We sometimes find in young Negro skulls, as well as in skulls of idiots (see figure 48, p. 145), traces of the maxillary suture; and, moreover, the sutures in apes are obliterated at various ages. Thus the sutures remain open in the gorilla to an advanced age, and are only closed in the oldest skulls, whilst in the chimpanzee the union takes place immediately after the change of teeth. I have now before me skulls of the same age, of the genus *cebus,* in which the teeth had just been shed. In one genus (*cebus apella*) the intermaxillary is plainly separated; in the other (*cebus albifrons*) the union with the maxillary is so perfect that there is no trace of any suture.

Fig. 49. Base of the Skull of *Cebus Apella,* with the Maxillary Suture.



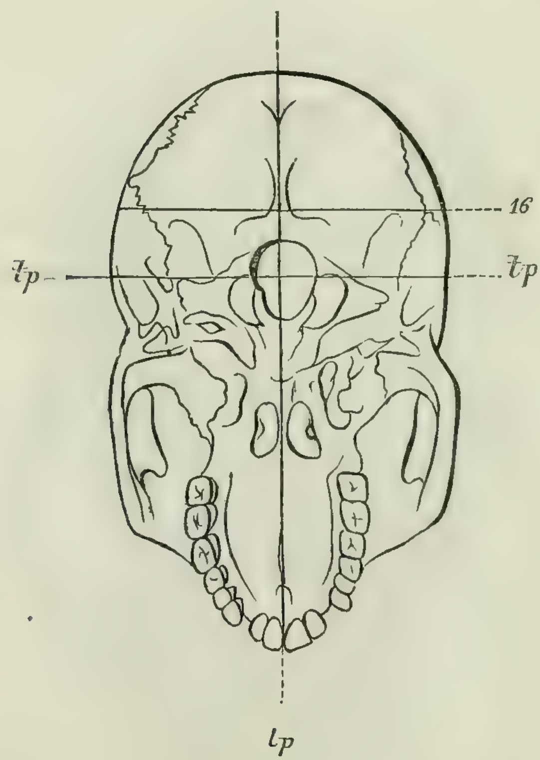
The formation of the rows of teeth, and of the teeth themselves, is closely connected with the projection of the muzzle (prognathism), which in the ape reaches a far higher degree than in the lowest human races; the palate becomes long and narrow; the rows of teeth, on the whole, parabolic instead of elliptic; the teeth themselves are distinguished by their size, hardness, and whiteness. The formation of their crowns, of the cusps of the molars, and of the chisel-like edge of the incisors, is so extremely similar, that it is possible to be in doubt about a single tooth, as to whether it is human or simian; but the doubt is no longer possible when the whole row of teeth can be inspected. It is specially the canine teeth which in apes destroy the harmony of the dental structure.

Fig. 50. Base of the Skull of *Cebus albifrons*.—The Maxillary Suture is obliterated.



The pointed crowns are frequently grooved, so that in some baboons they resemble short, curved daggers. They rise above the level of the other teeth, so that it would be impossible for the mouth to be perfectly closed were there not gaps for the reception of the projections of the canine teeth: indeed, in the upper jaw of all ape-skulls there is a gap, or diastema, between the canine tooth and the incisors; in the lower jaw there is a diastema between the canine and the first molar tooth; and even where the canine tooth is least developed, as in the chimpanzee, this gap is plainly seen; but is very large in the gorilla and in the baboon. At the same time the prominence of the muzzle towards the nose indicates the comparatively

Fig. 51. Base of a Kaffir Skull, with a Simian Diastema.



large and strong root of the canine tooth. But as there is great variation in the general structure of the ape, so shall we

find many transitions to the human structure. The canine tooth generally rises a little above the level of the others; but frequently it is considerably higher, and in closing the mouth is received into an imperfect gap formed by the summits of the opposite teeth. We moreover observe, though rarely, such gaps in human skulls, otherwise perfectly normal, as in the Kaffir skull from the Erlangen Collection, figured in Wagner's *Atlas of Comparative Anatomy*, and which we here reproduce. (See fig. 51.) A series of skulls exhibiting similar abnormities, with such occurring in other parts, might afford some indications as to the original stock; just as Darwin has directed attention to the dark transversal rings sometimes observed on the feet of horses, which apparently indicate descent from a stock common to the zebra, quagga, and other striped wild species of horses; so might the occurrence of dental gaps among Kaffirs and other inferior races indicate their earlier common origin. We must, however, not infer that an unbroken row of teeth is a distinctive human character. Thus in the anoplotherium, a pachydermatous fossil animal, found near Montmartre, there may be seen a perfectly unbroken row of teeth formed of incisors, canines, and molars. This, at any rate, proves that an even set of teeth does not form a distinctive human character.

The lower jaw is in the anthropoid apes massive, and the horizontal arm much longer, broader, and stronger, than in man; but the projection which forms the chin is absent. The chin may therefore be considered as a human character, though it recedes gradually in the lower prognathous races approaching the ape type.

The double curvature which is so striking in the vertebral column of man, is entirely lost in the ape, where the spinous processes of the cervical vertebræ are longer, stronger, and appear simple at the points, whilst in man they are divided by a shallow groove.

The Pelvis presents great variations. However narrow and elongated the human pelvis may be, it never, in this respect, resembles that of the ape, in which the iliac bones rise vertically and incline to the sacrum, whilst in man they spread out

Fig. 52. Side view of Male Pelvis.

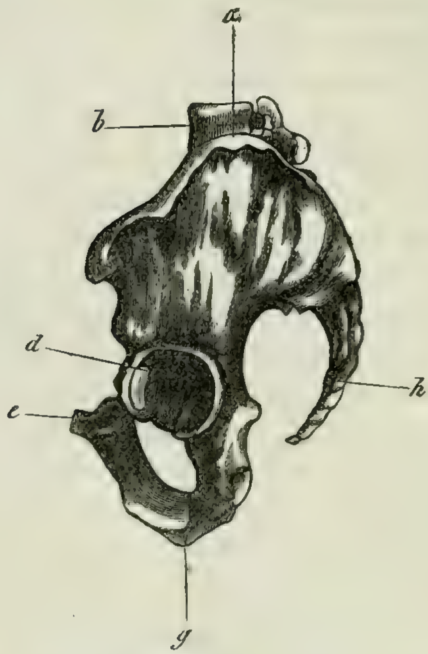
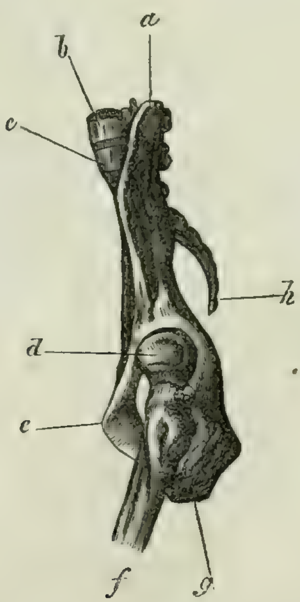


Fig. 53. Pelvis of a Male Chimpanzee, side view.



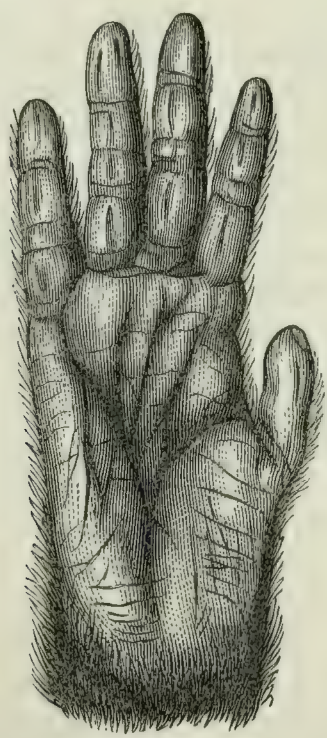
The description is, in figs. 52 and 53, the same. *a.* Ilium. *b.* Third lumbar vertebra. *c.* Fourth lumbar vertebra. *d.* Acetabulum. *e.* Os pubis. *f.* Femur. *g.* Tuber ischii. *h.* Coccyx.

in the form of a dish. Whilst the form of the superior portion of the pelvis, as already observed at the beginning of this lecture, seems to be regulated by the burden of the bowels, the lower portion is closely connected with parturition and the form of the head which is to pass through its aperture. Now the long, narrow, and thin head of the young ape can easily pass through a narrow pelvis, whilst the more rounded human head requires a wider diameter in every direction.

On examining now the LIMBS we find both in their proportions and their relations to each other a marked difference. Whilst the leg of man, as the sole organ of support, is heavier and more massive in its component bones, the leg of the ape resembles the anterior limb. In man the thigh bone (femur) is the longest and heaviest of the whole skeleton; in the chimpanzee the humerus equals it in length, in the gorilla it slightly exceeds it, and in the orang it does so greatly. The chimpanzee in a forced, erect position, which he, like the other apes, never assumes, can reach the knee with the end of the middle finger; and the orang can reach its ankles without bending. The difference becomes still greater when we study the proportion of the parts. Assuming the length of the humerus to be = 100, the length of the radius in the white man is = 75·5, in the chimpanzee = 90·8; the length of the hand in the white man = 52·9; in the chimpanzee, 73·4; and in the other apes, specially in the orang, these proportions are still more striking. The humerus is therefore proportionately shorter in the ape than in man, but the forearm and the hand are longer. According to Professor Aeby's measurements, which have not yet been published in detail, the gorilla alone among the apes entirely agrees with man as regards the dimensions of the upper extremities. The other anthropoid apes, however, differ greatly from man in this respect. Now compare the hand of the chimpanzee (fig. 54) with its long, narrow fingers, thin, insignificant thumb, long, narrow, flat palm, in which the ball of the thumb scarcely projects, with your own broad hand, its powerful thumb and well developed ball, the projecting cushions on the lower surface of the fingers' ends; and you will at once, even without examining the skeleton, perceive the great differ-

ence in the development of the hands in the two genera. But now, instead of the hand of the chimpanzee, take that of the gorilla. Its breadth and the thickness of the thumb so much approach that of man, that, as Huxley justly observes, there is more dissimilarity between the hand of the orang, which has one bone more in the carpus, and that of the gorilla, than between the hand of the gorilla and that of man. It is not necessary to shew farther how the gorilla, with regard to his limbs, presents a perfect transition from the ape to man. If an isolated arm of the gorilla were found in a fossil state, it would unhesitatingly be ascribed to a species of man; just as the cranium of a microcephalus would be regarded as a new species of ape. The difference is still more marked in the leg, not so much as regards the relative length of the several parts as in the internal structure. Assuming, again, the length of the

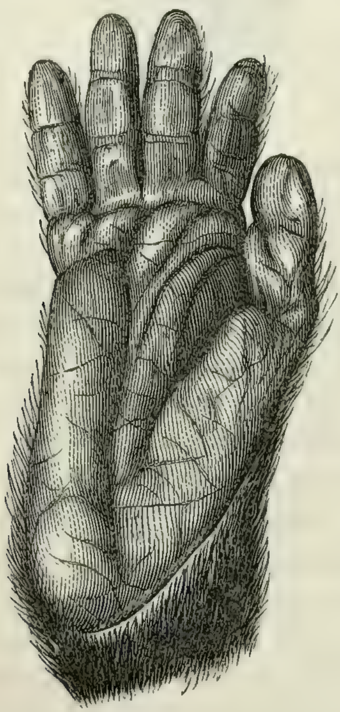
Fig. 54. Hand of the Chimpanzee: the palm.



femur = 100, the European presents the following proportions: tibia = 82·5; foot = 52·9; whilst in the chimpanzee the proportion for the tibia is = 80; but for the foot, 72·8. Here the extremity of the limb acquires the greatest length.

This organ, compared with the human foot, is a real hand. True, the fingers are somewhat shorter, the thumbs larger and thicker than in the anterior hand; but still it is a hand, with a flat lower surface, well-separated, moveable, drawn-out fingers, with opposable thumbs, and a long furrowed palm. On comparing a sketch of this hand with that of a human foot, we first perceive that Burmeister was right in designating (*Geologische Bilder*) the foot the specific character of humanity. The strength and length of the great toe, which generally exceeds in man those of the other toes; the smallness and imperfection of the other toes, which can generally be moved only together,

Fig. 55. Foot of Chimpanzee: the sole.



not separately; the projecting anterior cushions, formed by the bones of the metatarsus; the vaulted juncture of the meta-

Fig. 56. Skeleton of the Human Foot, top view.

tarsus with the tarsus, which equalises the weight of the body upon the whole arch, favouring the raising of the foot and the elasticity of the sole; the narrow but high heel, which projects but little backwards;—all these peculiarities in the structure of the human foot constitute it an important organ as regards the characters differentiating man and ape. But here, too, we must not forget that connecting links exist. The foot of the gorilla is more anthropoid than that of any other ape, and the foot of the Negro more ape-like than that of the white man. The bones of the tarsus in the gorilla exactly resemble those in the Negro; the ape has the same broad, flat, low heel; the large toe is thicker and longer than in the other apes, but the toes, on the whole, are longer, more moveable, and the thumb more opposable. "The posterior limbs of the gorilla," says Huxley, "terminate in a real foot, with a moveable great toe. It is a prehensile foot, if you like, but no hand,—a foot which differs from that of man, not in any fundamental character,

but in mere proportions in the degree of mobility, and in the secondary arrangement of its parts."

Fig. 57. Foot of Gorilla, after Huxley.

Still, we must bear in mind that the ideas "hand" and "foot" may be very differently conceived, and that they run into each other. Whilst most anatomists consider the essential part of the idea "hand" to be the opposability of the thumb, I. Geoffroy St. Hilaire justly observes, that many species of apes of the Old and New World, as the *colobus* and *ateles*, have no thumb at all, or only a rudimentary one in the anterior limbs, and that the opposable thumb is in apes always more developed in the hind limb than in the anterior one, whilst the reverse is the case in man. Whilst, therefore, Huxley restricts the notion hand so much, that he terms the posterior extremity of the gorilla a prehensile foot, Geoffroy St. Hilaire calls, on the contrary, every extremity a hand, though it be thumbless, provided it has long and flexible fingers, capable of prehension. According to this definition, most birds, especially parrots, also possess hands.

We now proceed to some internal organs, and especially to

the brain. Within the last few years, as I have previously stated, there have been, as regards the central organ of the nervous system, two contending parties in the field. The question was :—Does the brain of the ape, in its fundamental plan and its parts, differ from the human brain? This question has greatly agitated the scientific world; and though it now seems decided by the clearest evidence, we still find, as frequently occurs in the history of science, the standard-bearer of one side vainly defending his position. This reminds us of the anecdote of Thénard, who, in a lecture on chlorine, had among his auditors Berzelius, the only chemist who insisted upon the compound nature of chlorine. "On one side," observed Thénard, "we see the whole army; on the other side, a single man, whom, however, this once only, the army refuse to follow, but who outweighs them all, whoever they may be." So, too, we may say here: all against one,—but the one is Richard Owen.

Man has neither absolutely nor relatively the largest and heaviest brain among the mammals. The large aquatic mammals, as the whale, finner, sword-fish, large dolphins, and the elephant among land animals, have brains of more than two to three pounds in weight. The small American monkeys, the sajou, sai, and saimiri, have, in proportion to the body, a relatively larger brain, which, in man, is 1 : 36, and in the former as 1 : 13, 1 : 24 : 25. Although the emaciation of monkeys which die in menageries is very great; still, this much has been proved by the weighing of their brains, that man possesses no advantage as regards the cerebral mass.

On the other hand, his brain is much larger in relation to the spinal cord and the cerebral nerves; and the cerebrum is also larger in relation to the cerebellum. Even in this respect the lower races approach the animal structure, and the Negro is as much distinguished from the white man, by the comparative thickness of the spinal cord and the nerve trunks, as the ape is from the Negro.

I shall do myself the pleasure of making you acquainted with the present state of the dispute among naturalists concerning the cerebral structure of man and ape. I confess, the

pleasure is rather a malicious one. We see how they play hide and seek in three or four corners; how, when obliged to leave one corner for another, the player finds another player who cries out to him, "You can't stay here; find another corner." "The human character," exclaims one philosopher, "lies not in the developed form of the adult, but in the mode of development"; immediately there comes another, who says, "Nonsense! the character lies in certain parts which are peculiar to man." "False!" replies a third, "the ape, also, has these parts; it is the general type which constitutes the difference." "Wrong again!" says a fourth, "that is exactly the same in both,—but the brain does not constitute the difference; 'tis the mind!" "Mind, spirit?" asks a fifth, "there is no qualitative difference, only a quantitative one; but the structure,—the parts,—there it is!"

"In man," says Owen, "the brain presents an ascensive step in development, higher and more strongly marked than that by which the preceding sub-class was distinguished from the one below it. Not only do the cerebral hemispheres overlap the olfactory lobes and cerebellum, but they extend in advance of the one, and further back than the other. Their posterior development is so marked, that anatomists have assigned to that part the character of a third lobe,—it is peculiar to the genus *Homo;* and equally peculiar is the posterior horn of the lateral ventricle, and the hippocampus minor, which characterise the hind lobe of each hemisphere. Peculiar mental powers are associated with this highest form of brain, and their consequences wonderfully illustrate the value of the cerebral character; according to my estimate of which I am led to regard the genus *Homo* as not merely the representative of a distinct Order, but of a distinct sub-Class of the *Mammalia,* for which I propose the name of ARCHENCEPHALA."

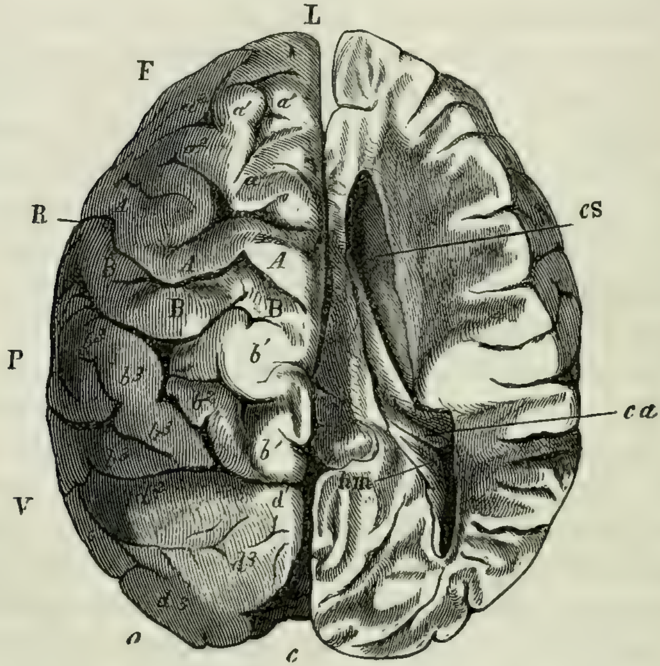
Huxley replies to this:—"I shall prove,

"1. That the third lobe is neither peculiar to, nor characteristic of man, seeing that exists in all the higher quadrumana.

"2. That the posterior cornu of the lateral ventricle is neither peculiar to, nor characteristic of man, inasmuch as it also exists in the higher quadrumana.

"3. That the *hippocampus minor* is neither peculiar to, nor characteristic of man, as it is found in certain of the higher quadrumana."

Fig. 58. Top view of brain of the Chimpanzee, after Marshall.



On the right side, the ventricle with the posterior cornu, are laid open. For description, compare figures 30 and 36.

The English now begin energetically to study the anatomy of the simian brain; Marshall dissects a chimpanzee; Rolleston, an orang; Huxley, an *ateles;* preparations, drawings, and photographs are made, and—Huxley's assertions remain unshaken. Owen appeals to older drawings of Tiedemann, Van der Kolk, and Vrolik, to support his negative opinion; whilst his opponents appeal to the same works to prove their positive opinion. But this is too much for the phlegmatic Dutchmen. "Mr. Owen," they write, "has been carried away by his desire to upset the theory of Darwin (of which

Messrs. Schrœder Van der Kolk and Vrolik are not over fond), and we believe him to be in error. In order to prove that the Negro brain rises at once without any transitionary stage above that of the anthropoid apes, Mr. Owen asserts that the posterior lobe of the hemispheres, the posterior cornu of the lateral ventricle, and the *pes hippocampi minor*, which exist in the Negro brain, are absent in the former." The Dutch anatomists now maintain that they have found and delineated all these parts, and that singularly enough, whilst praising the correctness of the sketches, he by a *contradictio in adjecto* denies the existence of these parts; they mention the researches of Huxley, Marshall, and Rolleston, and are glad to observe that they agree with their own. "We also are glad," they say, "that the zoological gardens, now-a-days, so easily furnish us with the necessary materials for comparison. An error, which formerly would have been perpetuated, is now more easily removed; but we feel grieved when we compare the assertions of Mr. Owen with the results obtained by the above eminent naturalists, which confirm our own."

And thus Owen's characteristic marks of the human brain are broken to pieces; and Wagner, of Göttingen, observes very justly, "I could never understand how comparatively insignificant cerebral parts, which vary in individual human brains, *e. g.* longer or shorter posterior cornua of the lateral ventricles, presence of the *pes hippocampi minor*, nay, some single or double medullary globules (*eminentiæ candicantes*), could be urged to be distinctive marks of the human brain, as distinguished from that of the anthropoid apes."

This being disposed of, the convolutions are taken to task. These, it is said, are in man rounder, more complicated, more numerous, and less symmetrical. All this is very true; but like the proportions which the nerve-trunks, the spinal cord, and the cerebellum, bear to the brain, they furnish only relative and quantitative, but not qualitative differences.

With regard to the general arrangement of the convolutions, Gratiolet expresses himself as decidedly as concerning the general cerebral structure. "On comparing a series of human

and ape brains," says this author, "we easily detect the remarkable analogy of the cerebral form in all these creatures. The folded brain of man, and the smooth brain of the Ouistiti, resemble each other by a fourfold character,—a rudimentary olfactory bulb, a posterior lobe covering the cerebellum, a well marked Sylvian fissure, and a posterior cornu of the lateral ventricle.

"These characters co-exist only in man and the ape. In all other animals the cerebellum remains (partly) uncovered; in most, even in the elephant, there is an enormous olfactory bulb; and, excepting the makis (lemur), no other animal presents the Sylvian fissure.

"Thus there is in man and ape a peculiar cerebral form; and there is also in all these creatures a general type in the arrangement of the cerebral convolutions. This resemblance of man and ape in the arrangement of the convolutions is worthy the attention of the philosopher. There is equally a particular type of the cerebral convolutions in bears, cats, dogs, makis, in short, in all natural families of animals. Each of these families has its normal type; and in each of these groups the species may be connected solely according to the character of the cerebral convolutions."

Wagner fully agrees with Gratiolet. "The fundamental development of the lobes in the large, lesser, and central brain; the limitation of the lobes in the cerebrum to intermediate, frontal, parietal, *occipital,* and temporal lobes, are in the quadrumana, as well as in man, arranged according to the same plan; and so are the chief fissures between them,—the Sylvian, Rolando's, the *occipital fissure,* the overlapping of the cerebellum by the *well-developed posterior lobe* of the cerebrum; all this gives more or less, to the lowest simian brain, a striking physiognomical resemblance to the human brain."

There is, then, nothing more to be said on this point; the general plan is and remains the same, and I cannot prove it better than by placing some drawings of human and simian brains in juxtaposition. But there are certain people who never give in. Distinctive characters must exist; how can you otherwise explain man's exceptional position? or how

can you otherwise separate him from the animal kingdom? If man, both in his mental qualifications as well as in his cerebral functions, possesses not merely a something more (what no one denies), but something else not existing in other animals, which he *must* have if he is to be capable of religion, of salvation, and of immortality; then there should be something in his brain, were it only an organ of faith!

Fig. 59. Brain of Macacus silenus, upper surface, after Gratiolet.

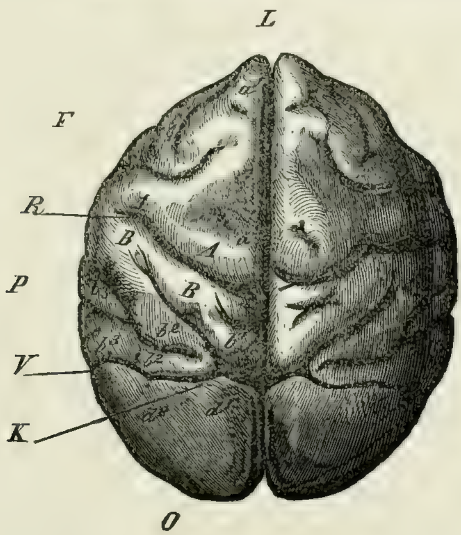
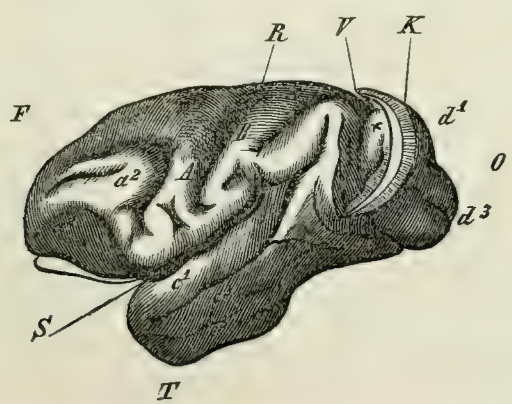


Fig. 60. Side view of the same; the operculum is reflected to display the subjacent transition convolutions.



The description in both figures is the same as in the Chimpanzee brain, fig. 58 (compare figures 30 and 36). *K*, operculum; *x*, transition convolution covered by the operculum.

Prof. Wagner finds such an organ—with Gratiolet. "The superior apes approach man gradually as regards richness of convolution, depth of fissures, and the presence of the *gyri breves* in the central lobe of the island, and greater *asymmetry*, etc. But they are far behind man as regards the preponderance of the large hemispheres, especially as regards their proportions to the cerebellum; *and there are distinctive differences in the arrangement, size, and limitation of the posterior lobes,* which are always more developed in the ape and cover a portion of the convolutions, which Gratiolet terms *plis de passage* (transition lobes)." In a note to this, Wagner observes, "The posterior lobes of *the apes do not admit of a strict reduction of their convolutions to man.* That I have done so by way of essay in my tables, and have paid no particular attention to Gratiolet's *plis de passage,* was done in order to establish a more simple terminology, which may be useful in cerebral dissections."

I have distinguished some of the above words by italics to show how contradictory they are. First, it is said, the posterior lobes have a remarkable resemblance, then they exhibit a striking difference; and how? The only human character which Wagner is able to find, the cap-like covering of the transition convolutions, he estimates so little as to omit it altogether, simply for the sake of the terminology in dissections.

Let us now return to Gratiolet, from whom the facts are borrowed. "The shape, says this author, of the brain is known. Its elevation, the breadth of the frontal lobe, the anterior portion of which, instead of becoming pointed, is formed by a surface which corresponds to the expansion of the frontal bone. The depression of the Sylvian fissure, the richness and complication of the secondary convolutions distinguish at first sight the human from the simian brain.

"Yet in spite of these differences, however great and characteristic they may be, when *we compare the proportions of the individual parts,* there still remain between the human and the simian brain such analogies that a general description is sufficient for both."

Further on he says, "This is an essential character; *in man all transition convolutions are superficial.*" This fact is signi-

ficant in the highest degree, when the question applies to the comparison of the cerebral convolutions in man and the ape. In fact:—

1. In the chimpanzee the posterior lobe is large and the operculum well marked. The upper transition convolution is wanting, the second is covered.

2. In the orang the posterior lobe is moderate and its operculum imperfect. The superior transition convolution is large and superficial, the second covered.

3. In man the posterior lobe is much reduced, the operculum is absent. The two superior transition convolutions are large, undulating, and both superficial.

"Does not this regular gradation tell its own tale?"

The question does not turn here on the two superior transition convolutions, which are both in apes and men superficial and uncovered; but on the two superior, and not even on both of them, but on the second, for the superior is in the orang as in man, uncovered, superficial, and free. Then there is the operculum, which, though imperfect, exists in the orang. I now write in my note book: Man is distinguished from the ape by the absence of an imperfect operculum and by the second transition convolution being uncovered. I may here apply Wagner's observation that we can hardly consider insignificant variations, as the second *plis de passage*, which, in some cases, as Dareste (another convolution student) maintains, may in the same individual differ in both hemispheres, as characteristic marks of man. But I console myself by studying my Gratiolet, and I read of the devil's ape (ateles Beelzebuth). "We easily recognise the posterior lobe, it is of moderate size; anteriorly its limits are badly defined. The external vertical fissure is in fact obliterated by the development of the transition convolutions, *which are very large and all superficial.*

"*This circumstance is most important, as, hitherto, we have only found it in man.*"

But is it not remarkable that Gratiolet, in the second part of his Essay, which treats of the American apes (the devil's and the capuchin ape belong to the new world), establishes

by facts the fallacy of his assertions in the first part? Is it not still more remarkable that Wagner, who studies this treatise, makes extracts and long comments on it, adheres to the first part without reading the second, despite that the underlined passages are also rendered prominent in the original? And is it not most remarkable that M. Gratiolet, in the year 1860, that is to say ten years after he had submitted his memoir to the Academy, has so entirely forgotten his own results, that he straightway lays down the maxim, that the superficiality of the second transition convolution is "an absolute peculiar character of man?"

But Gratiolet tells us further, "In the adult state the arrangement of the cerebral convolutions is in the two groups (man and ape) the same, and in this respect there is no sufficient ground for separating man from the animal. But in the ape the convolutions of the spheno-temporal lobe appear (during the development of the embryo *in utero*) first, and those of the frontal lobe last; whilst in man the frontal lobe convolutions appear first, and the spheno-temporal convolutions last. Here, therefore, the same series of developments are from alpha to omega, and there from omega to alpha. From these facts it necessarily results: that no arrest of development can render the human brain more resembling that of the ape than it already is. This result is perfectly confirmed by the brains of the microcephali."

Let us examine these alleged facts. The first relates to the history of the development of man and ape. Is this difference so absolutely great? It certainly only depends on the circumstance that in man the frontal lobe is more developed, that the formative action is greater in that region. On this point Wagner justly remarks, "However much we may adopt Gratiolet's asserted development differences, there still obtains a decided similarity (analogy and homology) in the stages of cerebral development in man and the stages of development in the lowest monkeys up to the highest anthropoid apes. It is true that the frontal lobes in man have already in the first stages a certain peculiarity, specially in the early formation of the sulci. But there is a decided resemblance between the

nearly smooth hemispheres in the fifth month of the human fœtus and the unconvoluted brains of the small clawed monkeys. There is also a decided resemblance in the greater symmetry and scantiness of the convolutions of both hemispheres, the poor, compact, less furrowed and undivided frontal convolutions in the human fœtus in the sixth and seventh month on the one side, and a number of superior apes up to the anthropoid apes on the other."

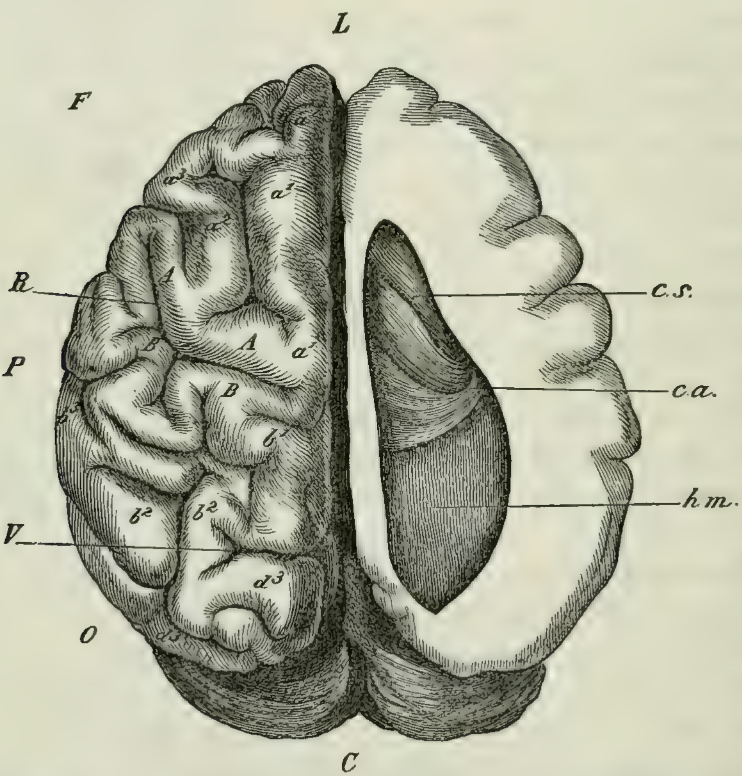
I would finally ask whether this development law has been traced in all races? As far as I am aware, no anatomist has examined Negro and Hottentot embryos of the fifth and seventh month. But we also know that skull and brain are so intimately connected, that they condition each other; we know, and Gratiolet has pointed it out, that the Negro skull follows, as regards the closing of the sutures, a different law from the skull of the white man; that the frontal and coronal sutures, as in the ape, close earlier than the posterior suture, whilst the reverse is the case in the white man. Would it then be so very hazardous to assume that this same simian development of the skull in the Negro extends also to the brain?

The second point refers to the microcephali. These unfortunate creatures who, according to Bischoff, are not men, will just prove to us that the human brain preserves its type under all circumstances.

The cerebral form of the microcephali consists essentially in an arrest of development, which, however, does not equally affect the whole brain, but chiefly the frontal lobes. The brain of all microcephali hitherto examined has in the anterior parts the same type as that of the anthropoid apes, being arrested in that stage "in which the embryonal human brain exhibits less developed convolutions and sulci, as is always observed in simian brains." In the posterior part the microcephalous brain is even behind the simian type. The cerebellum is not perfectly covered by the posterior lobe, whilst in all apes it is covered. This condition reminds us of the brain of the carnivora, and the form of the fœtus between the third and fourth month.

We are now told that the projection of the cerebellum is caused by the defective development of the posterior lobe, which is a decided character of man. "In the brain of our microcephalus," says Wagner, "it may in our cast be seen that the posterior and parietal lobes are reduced;" and in another passage, "The examination of seven or eight microcephalous brains showed that the atrophy of the convolutions

Fig. 61. The brain of an idiot, aged 26, described by Theile. The length of the hemispheres is reduced to the same length as that of the chimpanzee, fig. 58. The ventricle on the right side is laid open. The description is the same as in figures 60 and 30.



and the masses chiefly affected the posterior lobes and the posterior portions of the parietal lobes." "The microcephalic brain has just in its posterior part not the least resemblance to the Simian brain; it is a thoroughly human type, but atrophied."

Now, gentlemen, I have taken the trouble to subject these proportions to measurement, and as I had no materials at

command I have measured M. Wagner's delineations. I have, in the engraved brains of a microcephalus and a chimpanzee, measured two distances on the left side—the first from the apex of the brain to the vertical fissure which separates the posterior lobe, the second from the above fissure to the end of the posterior lobe. I find for these measures, in the chimpanzee: length of the anterior lobe = 76 millimetres; of the posterior lobe = 21 millimetres;—in the microcephalus: length of anterior lobe = 75 millimetres; of the posterior lobe = 20 millimetres. I further find from Wagner's measurements of the cerebral surface, that it is to the surface of the posterior lobe: mean in eight males = 100 : 16·2; that, on the contrary, in the microcephalus, the proportion is = 100 : 68·5; that, therefore, the posterior lobe presents a surface four times greater in the microcephalus than in the adult man; that, therefore, the idiot has a posterior lobe at least as much developed as the ape.

Result.—The posterior lobe is in the microcephalus just as large as in the ape; the idiot has in proportion to the cerebrum exactly as large a posterior lobe as the chimpanzee. The idiot has not the deep transversal fissure, nor the operculum of the chimpanzee, but no more has the devil's ape, and it cannot be said that the human embryo could lapse into the chimpanzee, whilst its posterior lobe resembles that of the devil's ape as closely as one egg resembles another. Here, therefore, the size and form of the posterior lobe is exactly as in the ape; the cerebrum, the anterior and posterior lobes, have the simian type.

The cerebellum is not quite in the same condition, as it projects behind. But this only results from its size, being less arrested it approaches the normal human cerebellum, having become too large in proportion to the arrested cerebrum. This also can be shown by the measurements by Wagner of the brains of four microcephali and an old orang.

	Mean of the 4 Microcephali.	Orang.
Length of cerebrum - -	110·25 - -	101
Breadth of cerebrum - -	79·25 - -	108
Breadth of cerebellum -	78·75 - -	86

In short, the microcephalic brain has, by arrest of development, which advances from behind in a forward direction, become strikingly analogous in the general arrangement of its parts to the simian brain, and none of the assertions which recognise in it a particular type are consistent with truth.

The difference between the brain of the microcephalus, who is only an abnormally formed man, and that of the lowest race we know, the brain of a bushman's wife, which according to Gratiolet would have produced idiocy in a white man, is thus greater than the difference between the brain of an idiot and that of an ape. The idiot who has remained stationery in a primary stage, stands nearer to the ape than to his progenitor. The distance which his brain has to pass to perfect human development is greater than the distance it has passed from the simian stage. Thus, everywhere we find only variation, intermediate stages which certainly do not all lead to the same point, but run to and fro in different directions.

LECTURE VII.

Comparison of Negro and German.—Bodily proportions of the Negro.—Skull.—Pelvis.—Proportions of extremities: arm, hand, leg, foot.—Internal Parts.—Brain.—Face.—Deviations from the normal type.—Differences of Colour.—Insensibility of the Negro.—Babies, and their development.—Remarkable change about the period of puberty.—Mental Inferiority of the Negro.—Constancy of differences.—Resemblance to the Brute.—Intermediate form between Man and Ape.—Microcephali.—The Aztecs.

Gentlemen,—By a scientific investigation of the facts, we have arrived at the conviction that essential differences between man and the highest anthropoid apes do exist—differences sufficiently important to induce us to assign to man a distinct rank in the animal kingdom, but by no means so great as to obliterate the close affinity subsisting between man and the animals standing next to him. We have in these investigations, to some extent, idealised both man and ape without noticing the differences obtaining within each of these groups, and have only endeavoured to establish for each the abstract collective conception which these various forms compose. We have preferentially paid attention to the heads of these groups. Among the apes we chiefly noticed the anthropoid group, and among the human group the white race. But here already we soon detected that even among these groups there appeared forms which, on comparison, might be separated; and that as among the superior apes, the orang, gorilla, and chimpanzee, represent three types, which in certain parts of their organisation approached man's structure, and in others deviate from it; so there appear within the human group different types, which in some points approach the simian, and in others the highest human type. We shall, in the investigation of these facts adopt the same method we have hitherto followed. We now no longer oppose the generic

conception "man" to that of "ape"; but we compare two well defined human types in order to determine the characters which distinguish these typical organisms. We select for this purpose the two extreme human types, namely, the NEGRO and the GERMAN, and comparing them side by side, as regards all their peculiarities, we may ascertain the degree of their differential character. The result thus obtained we shall in our next lecture compare with what we may be able to deduce from the comparison of two acknowledged simian types. It will then be seen whether the sum of the differences existing between two human races is greater or less than that obtaining between two kinds of apes, the separation of which into two species is recognised by all naturalists. It will also be seen whether we mete by the same measure, by assuming in apes a difference, and in man the unity of species.

I know full well that this method will be objected to. You select, it will be said, the Negro and the German, who, by your own confession, stand at the extreme limits of the human group, and you will probably select two species of apes which are closely allied, belonging to the same genus and only separated by some slight variations. We should not be surprised if you find greater differences between Negro and German than between the two apes. I reply to this: species is species, and there is but one zoological science, the principles of which must apply equally to man and ape, and what in one of these types is called species must not in the other be called race or variety. If, then, the differences between Negro and German should be greater than those between the capuchin ape, the *cebus apella* or the sajou, it would follow that either the two human types must, like those of apes, belong to two different species, or the two acknowledged different species of apes must only form one species.

Let us now proceed in our investigations.

The NEGRO is on the average shorter than the German, the mean length of his body being 64-66 inches. Six Negro skeletons yielded as their mean length 160 centimetres; whilst as many European skeletons gave above 172 centimetres. There are no doubt athletic forms occurring among Negroes,

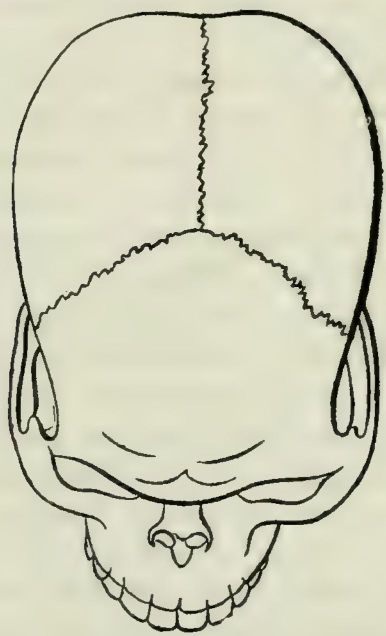
and some tribes among the blacks, just as among the whites, are distinguished by a high stature; but even these exceptionally tall Negroes never reach the length of the tall tribes among the Germans or Anglo-Saxon races, and no such giants will be found even in the most privileged black tribes, as are occasionally found among the whites.

The proportions in the corporeal structure greatly differ. The trunk is smaller in proportion to the extremities, specially to the arm, which in the Negro reaches below the middle of the femur. Most Negroes can, without stooping, reach with the finger's end the region above the knee-cap. The neck is short, the cervical muscles very powerful, but the shoulders are narrower and less strong than in the white. There is a certain resemblance in the form of the neck to that of the gorilla, to which the remarkable development of the cervical muscles, combined with the shortness and curvature of this part, gives something of the aspect of a bull's neck. Surely it is for this reason that the Negro always carries his burden on the head, rarely upon the shoulders or back; and it is for this reason that he, like a ram, uses his hard skull in a fight. The chest is narrow, the antero-posterior is almost equal to the transverse diameter, which predominates in the German; the belly is relaxed and pendulous, and the navel situated nearer the symphysis pubis than in the European. Even in muscular Negroes the arms are less rotund, the hips narrow, the thighs laterally compressed, the calves lean. The Negro rarely stands quite upright, the knees are usually bent, and the legs frequently bandy. Hands and feet are long, narrow, and flat, and form the least attractive features in the Negro figure.

Most of these external characteristics remind us irresistibly of the ape: the short neck, the long lean limbs, the projecting pendulous belly—all this affords a glimmer of the ape beneath the human envelope. Such similarities are equally detected on examining the structure of individual parts. Commencing with the skeleton, we find that the bones are always beautifully white and hard, almost like ivory. The angles and rims are always more marked, and the contour of the individual bones coarser than in the European.

The skull is usually elongated, narrow at the forehead, the central line of the vertex rather depressed, the parietal surfaces flattened, the greatest breadth being in the posterior third. The Negro skull is the purest type of the long skull with receding forehead. On this small and narrow receding frontal bone the superciliary arches are moderate, the frontal eminences little marked, the nasal process broad, corresponding with the broad flat nose. The temporal fossæ are deep in front, but flat and lengthened backwards. On looking at the

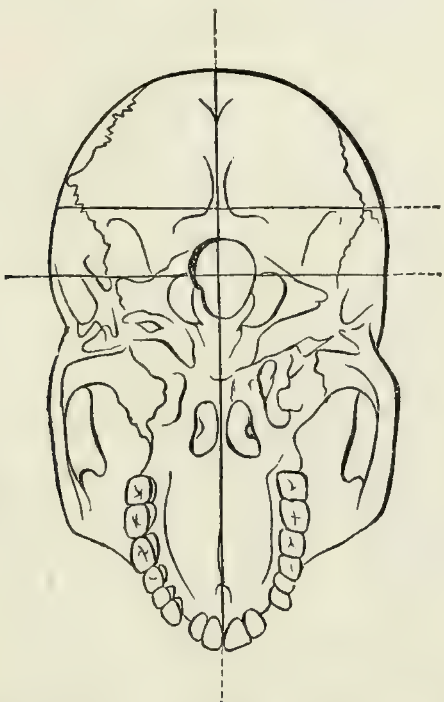
Fig. 62. Skull of the Negro, top view.



skull from above, it seems as if it had been compressed behind the orbits. The parietal bones are proportionately much larger than the frontal bone and the occipital squama, which are usually small and short. The sutures are usually fine but small, the Wormian bones, which in the European are frequently found in the lambdoid suture, are rare exceptions in the Negro. The base of the cranium is long, the occipital foramen rather long than broad and situated behind the centre of the line drawn from the alveolar margin of the upper jaw to the

most projecting rim of the occiput. The basilar bone is long and narrow, but the mastoid processes, as well as the petrous bone, are generally strong and thick, the brims of the occipital foramen rise above the flattened base. The facial skull is remarkably large in proportion to the cerebral skull.

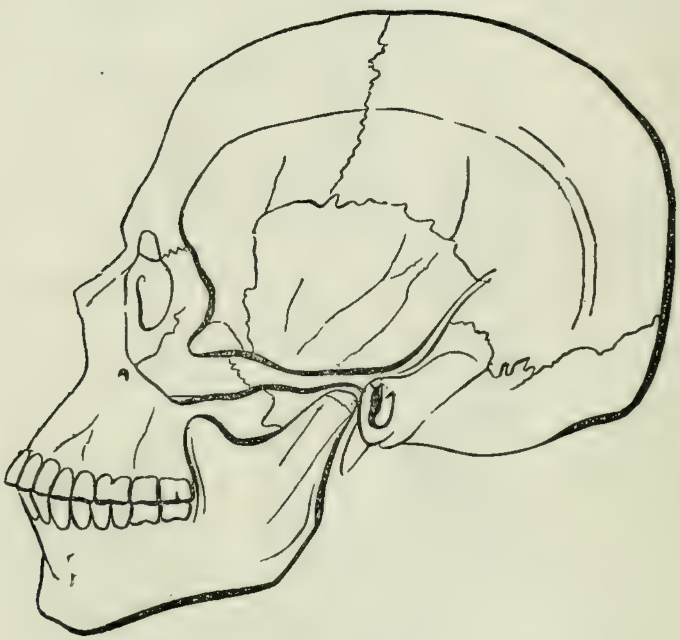
Fig. 63. Kaffir Skull, base.



The orbits are wide, funnel-shaped, their lower margin very thick, rounded and projecting, the nasal bones short, narrow, almost square, the nasal apertures broad, with rounded angles, the nasal spine is scarcely indicated, the upper jaws drawn outward, usually provided with knobs corresponding to the canine teeth, the cheekbones usually form prominent angles. According to Pruner-Bey, we may distinguish three kinds of prognathism. In the lowest degree the alveolar arch is elliptic instead of parabolic, outwardly convex, but the incisors are perpendicularly inserted, so that the prognathism is confined to this jaw. In the second degree the incisors are oblique, but are in the same line with the jaw; whilst in the third degree they form an obtuse angle at their insertion and exhibit

projecting edges. But in no case is the prognathism of the Negro solely confined to the position of the teeth and their cavities, it is the jaw which constantly contributes towards the projection of the muzzle. An interval, though of small extent, is not rarely seen in the upper jaw between the incisors and the

Fig. 64. Negro Skull, side view.



canine teeth. Soemmering found in some Negro skulls a supplemental molar in the upper jaw; two anomalies, which to our knowledge, have never been observed in Germanic skulls. This diastema reminds us of the ape in general. The additional molar in the upper jaw, by which such Negroes have thirty-four instead of thirty-two teeth, reminds us of the American monkeys in particular, which have thirty-six teeth, the increase extending to the lower jaw.

The osseous palate is not only absolutely longer, but absolutely broader than in the white, and these circumstances indicate the exceptionally great development of the jaws in general. The zygomatic arches are curved and wide, so that the tem-

poral muscles, presiding over the motion of the massive lower jaw, and filling the whole temporal fossæ, are larger and more powerful in the Negro than in the White. The lower jaw is, in fact, far more powerful and massive than in the white; the chin is retracted, broad, and rounded; the horizontal branch of the lower jaw is very long; the vertical broad and short, and forming an obtuse angle, so that a considerable force can be exerted. The size of the teeth, which are broad, long, and of glittering whiteness, corresponds to this. The substance of the teeth is, moreover, far harder than in the European, so that they are not so easily used up. I know dentists, who partly owe their reputation to the circumstance that during their stay in America they procured sacksfull of Negro teeth, with which they supplied the gums of our European ladies,—an operation which could be the more easily effected, since the female European skull resembles much more the Negro skull than that of the European male.

On further examining the proportion the cerebral-skull bears to the facial-skull, the simiousness in the Negro is exhibited by the greater development of what may be called apposition. The elongation of the skull, its narrowness in the anterior part, the recession of the forehead, cause, as it were, the brain to slide back from the face, whence the roofs of the orbits appear more oblique than in the European, and resemble the form seen in most mammals. The funnel-shape of the orbits is caused by this formation. The internal cranial capacity is, despite of its elongation, considerably smaller than in the German, the difference amounting to nearly 100 cubic centimetres or more, according to some measurements already given.

The facial angle of Camper amounts in the Negro to 70-75 deg., it may sink to 65, whilst in the German it is rarely below 80, and frequently a few degrees higher. In the German the saddle-angle (*ephippium*) is 134 deg., in the Negro, 138-150; the angle on the root of the nose, in the German 66 deg., is in the Negro above 70 up to 77.

On examining the other parts of the skeleton, we are at once struck by the fact that the S-shaped curve of the verte-

bral column is less distinct in the Negro than in the White, the column approaching in its arrangement that of the ape. The pelvis is further distinguished by its length and narrowness. All the diameters of the small pelvis, through which the head of the child must pass, are considerably smaller in the Negro. This applies specially to the large diameter, and we may say that, on the whole, the pelvis of the Negress (for in the female sex this part of the pelvis is much more spacious than in the male), as regards the smallness of its diameter, resembles the pelvis of the white man. This is not surprising, as the head of the Negro child presents already at birth all the characters of its race in the narrow and elongated head, and accordingly we find the narrow pelvis adapted to this form.

The pelvis of the male Negro, compared with that of the white man, appears larger, the iliac bones not broad key-shaped, and so that the upper parts lean on the sacrum almost like the shoulder blades on the superior extremities. The length of the extremities, and specially the proportions of the separate parts, are of particular importance.*

---

* I give here the proportions of the parts composing the extremities, assuming the total length of the body to be = 100, and expressing the length of the component parts in per cents, we obtain the following numbers, according to Burmeister's measurements:—

	MALES.		FEMALES.	
	Europeans.	Negroes.	Europeans.	Negroes.
Superior extremity.........	45·5	44·6	46	48·8
Upper arm..................	18·9	18·15	19	20
Fore-arm	15·9	14·77	14·3	16·7
Hand	10·6	11·5	9·5	11·7
Inferior extremity	51·5	51·9	49·2	51·7
Thigh......................	26·75	27·8	27	28·3
Leg........................	24·7	25·8	23·8	26·1
Foot	15·15	15	14·3	15·7

By calculating in the same way, Pruner-Bey's measurements of the skeleton, we obtain the following corresponding numbers, which, as the author himself observes, lay no claim to perfect correctness, as the total length partly depends on the manner in which the skeletons are mounted.

The arm by itself is perhaps somewhat longer than that of the European; still there are several Negro tribes, in which the proportion of the total length to that of the arm is nearly the same. But the proportion of the individual parts to each other varies: the humerus of the Negro is proportionately shorter, the forearm proportionally longer than in the German. This proportion is in the subjoined table apparent at once, and this, as has long been observed, is a decided approach to the animal type. The humerus exceeds, in all human races as well as in the anthropoid apes, the bones of the forearm in length; but this predominance, which is greatest in the white race, diminishes in the black, and sinks still further in the anthropoid apes. In the American apes the predominance is already reversed, so that from the monkeys through the whole animal kingdom the upper arm is shorter than the lower arm. Connected with this is a greater leanness and a more equalised distribution of the muscular fibres, so that the rotundity of the upper arm partly produced by the development of the biceps, and the spindle-shape of the forearm, is not seen in the Negro, both parts presenting in their whole length nearly the same thickness.*

	Europeans.	Negroes.	Europeans.[1]	Negroes.	Europeans.[2]	Negroes.[3]	Europeans.
Humerus.........	19·58	19·54	107·83	The corre-	100·2	100	100
Radius............	14·78	15·32	103·37	sponding ne-	96·5	78·7	75·5
Hand	10·94	11·58	101·62	gro limb is	94·47	59·3	52·9
Thigh (femur)..	27·29	27·94	105·10	everywhere	97·68	100	100
Leg (tibia)......	22·45	23·80	100·17	adopted =	96·43	85·2	82·5
Foot...............	14·51	15·40	102·04	100.	94·3	54·8	52·9

[1] This series is calculated according to the absolute numbers of measurement.

[2] This series is calculated according to the proportional numbers of the first two columns.

[3] This series shows the proportions of the middle and terminal members to the first member, which is assumed = 100.

* According to Aeby's measurements, the details of which are not yet published, the individual races and peoples are not distinguished as regards the proportions of the limbs and their parts. The difference in length of the forearm of the European and the Negro does not amount even to one per cent., and even this slight difference may, perhaps, be reduced by further and more extended measurements.

To the long lean forearm is joined a *hand* which has a decidedly simious character. Though the stature of the Negro and the Negress is on the average a few inches below that of the White, the hand of both sexes is always absolutely, mostly an inch or more longer than that of the white race. Besides this, the hand is narrow, the fingers long and thin, the cushion of the third phalanx scarcely perceptible, the nails narrow, flesh coloured, rounded at the end, but much arched. The palm is flat, the thumb-ball scarcely prominent, the coloration lighter than on the dorsum. The thumb is narrow and long, but weak, and reaches in the black to the middle of the second finger, and sometimes beyond. All these characters of the hand decidedly approach those of the simian hand, which is equally distinguished by narrowness, long fingers with curved nails, and slight difference between the thumb and the other fingers.

The disproportion between the limbs is still more developed in the Negress, in whom the arm is absolutely longer than in the male, whilst the upper arm is absolutely shorter. I will, however, not dwell on this, and bearing in mind that between the two sexes of the same species differences may and do prevail greater than between the same sexes of different species, I shall keep to the male sex. We may be sure that, whenever we perceive an approach to the animal type, the female is nearer to it than the male, hence we should discover a greater simious resemblance if we were to take the female as our standard.

The *leg* exhibits the same proportions as the arm. The leg of the Negro is proportionately somewhat longer than that of the European; not the *femur*, but the *tibia* and the foot. Hence it is that the ends of the fingers seem to reach farther down than in the White, as the knee is, from the shortness of the thigh, brought nearer the trunk. The femoral bones as well as the fibula seem curved outward, so that the knees are more apart from each other than in the White. This mainly arises from the narrowness of the pelvis, by which the articulating surfaces of the heads of the femoral bones approximate the central axis of the body. There is also a peculiar arrangement in the muscles of the legs, which appear thin, calfless, and

laterally compressed. The whole leg has the appearance of a wooden leg covered with skin, from the absence of fleshy muscles.

The *foot* of the Negro, says Burmeister, produces a disagreeable impression. Everything in it is ugly: the flatness, the projecting heel, the thick fatty cushion in the inner cavity, the spreading toes. Let us examine these characters. We have seen that the character of the human foot lies mainly in its arched structure, in the predominance of the metatarsus, the shortening and equal direction of the toes, among which the great toe is remarkably long, but not like the thumb opposable. In every public bath you may observe the following marks left by the wet feet: a round spot behind corresponding to the heel, in front a transverse spot almost pear-shaped, the thick part inwards, formed by the ball. Sometimes there is a small line, corresponding to the external margin of the foot, running towards the heel-spot, but rarely reaching it; the anterior, or ball-spot, corresponds to the articulations between the toes and the metatarsus; the toes in standing leave no marks, but do so in progression. The whole middle part of the foot does not touch the ground. Persons with flat feet, in whom the middle of the sole touches the ground, are bad pedestrians, and are rejected as recruits. If the same rule were applied to Negro regiments, the Pacha of Egypt could not have placed his soldiers at the disposal of the Emperor of the French for the Mexican Expedition. The Negro, says an American song, cited by Burmeister, makes with the cavity of his foot a hole in the ground. The Negro is a decided flatfoot, which, indeed, may be seen also in the skeleton, but much better in the living man, as the fat cushion on the sole not only fills up the whole cavity but projects beyond the surface, so that the ball and the heel do not exactly lie on the same plane with this pad. The toes of the foot are longer, narrower, more moveable and spreading than in the European, the great toe somewhat shorter than the second, but long and narrow and more removed, so that here we have again a decided approach to the form of a hand. But as we have seen the formation of a foot instead of a hand is an essential human

structural character, and it is specially the foot of the gorilla, or if you like, the posterior hand, which also in other respects presents a decided similarity to the foot of the Negro.

With respect to the internal organs, I shall chiefly quote the remarks of Pruner-Bey, who, as the physician of the Viceroy of Egypt, has ample opportunities for observation. "Soemmering," says Pruner, "had already remarked that in the Negro the peripheral nerves are very large and thick in proportion to the volume of the brain. This fact is rendered particularly evident by the excellent preparation of M. Jacquard in the Paris Museum.

"The narrow and elongated brain always presents on the surface a brown coloration, resulting from a considerable injection of venous blood. (Other obseivers attribute, in our opinion with greater probability, this dark colour to a greater deposition of pigment both in the grey matter and in the arachnoid membrane). The superficial veins are very thick; the grey substance presents internally a clear brown coloration; the white substance is yellowish; the cortical grey substance, which covers the hemispheres, is less thick than in the white. Viewed in front the brain presents a rounded apex; viewed from above the parts seem coarser and less manifold than in the white. The anterior and parietal convolutions seem less deep, flattened, excepting the third convolution, which rather protrudes on the frontal surface. On tracing the convolutions backwards, we find fewer of those parietal folds which render the brain of the white a perfect labyrinth. The convolutions on the middle lobe seem raised, but massive and coarse; the posterior lobe always appeared to me as flattened on the top as the anterior lobe is at the base. In the side view it is specially the direction of the Sylvian fissure which has engaged the attention of anatomists. I myself have never been able to detect in this respect an essential difference between the brain of the Negro and that of the Egyptian, though I placed them side by side. The part above the *corpus callosum* is comparatively less raised, the cerebellum less angular than in the European, the vermis and the pineal gland

are very large. The cerebral mass is undoubtedly firmer and more consistent in the Negro than in the White.

"In the brain of the Negro the central gyri are like those in a fœtus of seven months, the secondary are still less marked. By its rounded apex and less developed posterior lobe the Negro brain resembles that of our children, and by the protuberance of the parietal lobe, that of our females. The shape of the brain, the volume of the vermis and of the pineal gland, assign to the Negro brain a place by the side of that of a white child."

Huschke mentions some other differences. The Sylvian and Rolando fissures are more perpendicular than in the brain of the European; the anterior lobes are shorter, the gyri coarser, the chief anterior convolution broad, but all without islands. Huschke arrives at the conclusion that in the Negro brain both the cerebrum and the cerebellum, as well as the spinal cord, present the female and infantile European as well as the simious type. The resemblance of the Negro brain to that of the European female would be still greater if they were not distinguished, the former by its length, the latter by its breadth.

I possess no Negro brain, and I must confess that I have no confidence in the old representations, chiefly for this reason; that the convolutions, so important in our researches, are, in the figures of old authors, such as Tiedemann and Soemmering, not very faithfully rendered. But on examining the brain of the Hottentot Venus, an excellent representation of which is given by Gratiolet, and which by breadth and shortness deviates from the Negro brain, but exhibits in other respects the same type; and comparing it with the brain of a German and that of an anthropoid ape (see fig. 65-67), I find a remarkable resemblance between the ape and the lower human type, specially with reference to the development of the temporal lobe. The simplicity of the parallel fissure, the arrangement of the gyri, accord so much with those of the orang, that the brain of this bushwoman would certainly be rather placed by the side of the ape than of the white man, were there not a decided difference in the form of the posterior lobe and the operculum at its end. The frontal, parietal, and temporal lobes are, by their

coarse simple gyri, decidedly simious, still the brain of this woman belongs to the human type by the size of the hemispheres and the character of the posterior lobe.

Fig. 65. Profile of the Brain of the Hottentot Venus.

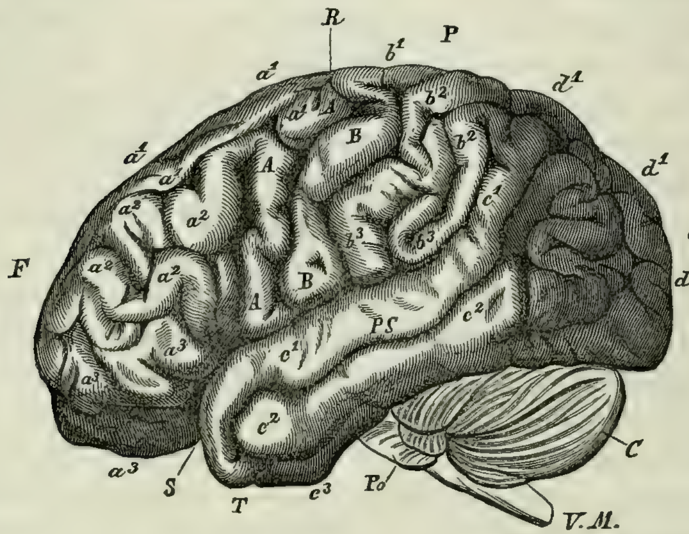
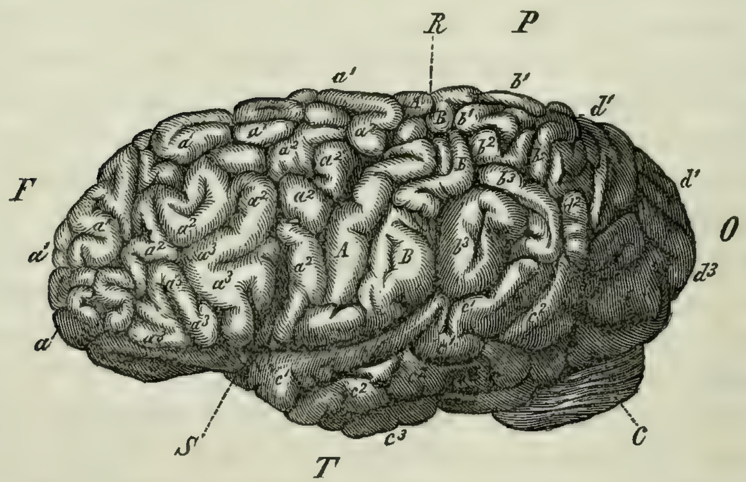


Fig. 66. Profile of the Brain of Gauss.

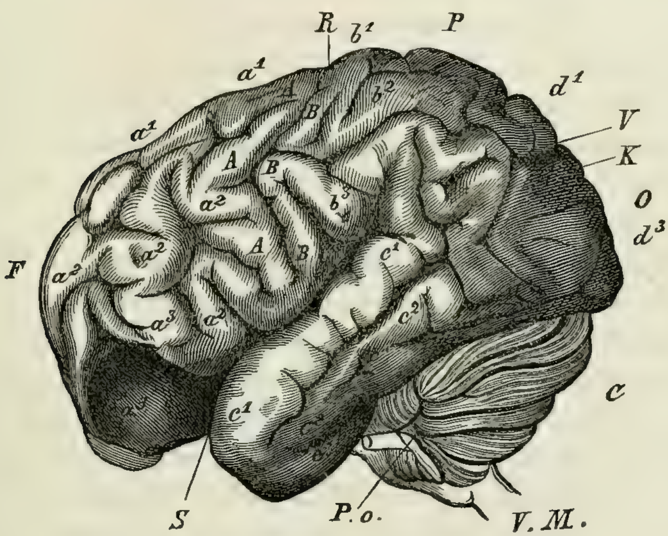


Of the other internal organs Pruner-Bey's remarks are as follows:—

"The eyeball is at least as large, if not larger, than in the

European; the cornea comparatively small and flattened; the pigment abundant; the iris dark brown mixed with yellow; the retina very firm. The glandular system is much developed, both upon the skin and in the internal mucous membrane; hence the intestinal canal has an uneven aspect, specially in the stomach and the large intestines. The mucous membrane is very

Fig. 67. Profile of the Brain of the Orang.



The description of the figures is the same as in figs. 31, 32.

thick and fatty. All the abdominal glands are large, specially the liver and the supra-renal glands. These organs seem gorged with venous blood. The bladder lies higher up than in the European; the large seminal vesicles were always, even in sections made shortly after death, filled with a turbid greyish fluid. The penis is always disproportionally large. The blood is always thick, black, and glutinous; it never is in bleeding projected in an arch, but adheres to the vessel, whilst the serum is more or less dark yellow. The lungs are comparatively less expanded than the abdominal organs, they are frequently filled with a black deposit, and are pressed back by the stomach, liver, and spleen. Black pigment spots are frequently met with on the tongue, the palate, and the conjunctiva, as well as in the mucous membrane of the intestinal

canal. The fat, as well as all fibrous and cellular tissues, the periosteum, and the conjunctiva, have always a yellow coloration. The mucous membranes of the mouth, nose, etc., are of a cherry red, but the lips of a bluish colour. Excepting the masseter, the aural and the laryngeal muscles, the development of the other muscles is not proportioned to the weight of the bones. In colour they are never so bright red as in the European, but rather yellowish or brownish.

"The face of the Negro is flat and narrow, frequently pointed downwards, whilst the cheek bones and the posterior parts of the cheek covered by the masseters are prominent, so that it seems as if the cheeks had been compressed in front. The aperture of the eye is narrow, horizontal, and both eyes are wide apart. From this depressed and wide nasal root proceeds a broad, flat, upturned nose, the apertures of which are so placed that viewed from below they seem to run parallel with the aperture of the eyes. The ears are remarkably small, the posterior margin much curved, the lobules small, but apparently thick and cartilaginous. The superior part of the face, with its retreating narrow forehead, low vertex, and prominent orbital margins, resembles perhaps more the simian face than the lower part with the projecting teeth, the white even of which is the more marked from the contrast with the brown or violet lips and the black face."

I know well enough that the description of the Negro-type, as here given, is that which, so to say, represents the purest type, and that there are many Negro tribes in which some of these characters are less distinct. Pruner-Bey summarises these deviations as follows:—"We must admit," he says, "that the inferior orbital margins are frequently narrow and retreating; that the nose becomes longer and more prominent; that the lips, turned up in some tribes, are only full in others; that prognathism diminishes, without however disappearing entirely, that the aperture of the eye becomes wider; that the hair, short and woolly in most, grows longer; that the transverse diameter of the chest becomes enlarged; that even the pelvis, though much more rarely, acquires more rounded outlines; that the limbs acquire more harmonious proportions; that the

hips, thighs, and legs become more fleshy and the foot more arched; but as regards the crowning of the work, *i. e.*, the skull, specially the cerebral skull, all the variations in the Negro race remain and are confined within limits which deserve our attention. In the Arian race the skull presents three fundamental types: the elongated form (producing in some exceptional cases slight prognathism) which approaches the boundary of the Negro-type; the short and round form, approaching the Turanian race; and, finally, the typically beautiful oval form, which seems to have resulted from a combination of the two former. Nothing like this is to be found in the Negro; his skull is, and remains, elongated, it is elliptical or cuneiform, but never round; the facial skull may approach the pyramidal form by a greater distance between the cheek-bones, and may in this respect resemble that of the Kaffirs and of the Bechuanas, but no more. Still, there is in Gall's collection the skull of an Austrian, the outlines of which correspond to the Negro type,* and Meigs mentions a Negro skull in Morton's collection, which, apart from a slight prognathism, might be taken for an European skull, as this eminent craniologist himself admitted. But assuming that these exceptional skulls belonged to individuals of pure descent, there would still remain sufficient characters—both in the living and the skeleton—to distinguish such individuals from the Negro, the White, or from any other race.

"This also applies to the regular Caucasian features, with which some travellers have endowed certain Negro peoples. Among many thousand Negroes who have come under my own observation, there was not one who could lay claim to it.

"Similar variations may also occur as regards the colour of the skin. The deep velvety black is very rarely met with. There are gradations from brown to grey, which latter colour imparts to the individuals a cadaverous aspect. Though the pigment of the Negro seems to be the same substance as the colouring matter in freckles and the tanned skin of the Euro-

* In the anatomical collection of Bern there is the skull of a murderer, which, on a superficial view, appears to me to possess more of the Negro type than any white skull I have yet seen.—C. V.

pean, it cannot be asserted that an European can be so browned by the sun, by exposure, or by affections of the liver, as to acquire even a light Negro skin. The equalised colour both in the covered as well as in the exposed parts, independently of other characters, makes a distinction between them very easy."

As regards the acuteness of the senses, the Negro stands far below the white race, and by no means confirms the opinion which attributes to savages and peoples living in a state of nature more acute senses. The eyes are frequently rather dim, and the flattened cornea seems rather to favour long-sightedness than short-sightedness. Smell, taste, or hearing do not seem highly developed. The Negro, however, shows great talent for plain cookery and vulgar music, so that in America nearly all the cooks and musicians are men of colour. Touch is not very delicate, the finger cushions being less developed in the black; "but," says Pruner, "the most remarkable phenomenon relates to *coenæsthesis*, as regards the Negroes apparent insensibility to pain. We have never seen the least spontaneous expression of pain; in the hospitals we see Negroes suffering from the gravest diseases cowering on their couches without taking any notice of the attending physicians. As a slave, he is more communicative, without, however, exhibiting greater sensibility to pain. Mishaps, or bad treatment will draw from the Negress, the child and even the adult Negro, an abundant flow of tears, but physical pain never. The Negro frequently resists surgical operations, but having once agreed to submit, he fixes his eye on the instrument and the hand of the surgeon without the least mark of pain or impatience, though his lips become blanched and the perspiration runs down his body during the operation. As we see, the Negro is a born stoic, certainly more from disposition than from habit or education."

Even with regard to the development of the Negro child, I can do no better than follow this experienced Egyptian physician. "The Negro child," says Pruner-Bey, "is born without prognathism, but with a totality of features which, though characteristic for the soft parts, are not yet expressed in the skull. The Negro, the Hottentot, the Australian, the New

Caledonian, do not, with regard to the osseous system, exhibit the differences which arise subsequently.* The new-born Negro child has not the colour of its parents; it is reddish nut-brown, and the redness is less vivid than in the case of a new-born white child. The colour soon becomes slate-grey, and more or less rapidly corresponds to that of the parents, according to the surrounding media among which the child grows up. In the Sudan the development of the colouring matter is generally finished within a year, in Egypt within three years. The hair of the Negro child is at first rather chestnut-brown than black, it is straight, and only curled at the ends. I have not been able exactly to determine the extent of the fontanelles, but there does not seem to exist a measurable difference in this respect from those of the white child." (Burmeister remarks concerning the differences in new-born children. "The hair is not crisp or black, but is of a chestnut colour, and has a silky fineness. In growing, it becomes gradually darker, and more crisp, until the time the child learns to walk, when the hair is perfectly woolly. This reminds me of the down of young birds in relation to the feathers of the hen.")

"The first dentition," continues Pruner-Bey, "commences nearly at the same time as with us; I have, however, also observed cases of premature, as well as of retarded dentition. Lactation lasts never less than two years. On the completion of the first dentition, we perceive already in the skull the peculiar characters: the raised central line in the forehead, the retreating chin, the slightly projected upper jaw, the flat nose, the dazzling whiteness of the teeth, the prominent occiput. The young Negro possesses, however, a pleasant physiognomy up to puberty, which commences in girls between the tenth and thirteenth, and in boys between the thirteenth

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* This opinion of Pruner-Bey seems to me hazardous, and not founded on sufficient observation. I have had no opportunity of examining a new-born Negro-child; but in Blumenbach's *Decas Craniorum* there is such a figure, which, at the first glance, shows the great length and narrowness of the cranium, as well as prognathous jaws. When we take into consideration the narrowness of the pelvis of the Negress, it must follow that the skull of the newborn Negro should present dimensions different from that of the Arian child.

and fifteenth year. This is followed by a rapid transformation in the forms and proportions of the skeleton. The transformation proceeds differently in the cranium and the face; the jaws predominate without an adequate compensation in the cranium. It is not meant that there is exactly an arrest of development; but that the race difference consists in the different growth of individual parts. Whilst in the white man the gradual increase of the jaws and the facial bones is not only equalled but exceeded by the development or rather enlargement of the brain, and specially of the anterior lobes; the reverse is the case in the Negro. The muscles subservient to animal life cause a compression on the sides, which is but little resisted by the brain. In this way the cranium obtains the shape previously described. As everything in the organism is harmonious, this theory of cranial formation may be contested, but the mode in which the sutures close furnishes an important commentary on these phenomena. The central frontal suture closes in the Negro in early youth, as well as the parietal part of the coronal suture.* With advancing age the central portion of the coronal suture, the saggital suture, and all parietal sutures close, nearly simultaneously, as I have observed in skulls from East Africa. The lambdoid suture remains open the longest, specially at the apex. At the base of the cranium we find, on the contrary, the suture between the sphenoid and the occipital bone still open, and the suture between the incisors is not only seen in the Negro child, but in many old Negro skulls. Generally speaking, the sutures in the Negress close sooner than in the Negro.

"Prognathism may, perhaps, be partly considered as the result of the action of the lower jaw on the concentric arch of the upper jaw. At any rate, the mode of its direction towards the temporal bone contributes to it; for I have found this formation principally in races where the sockets for the lower jaw are broad and less deep, whilst the heads are flat or at least elliptical. This agrees with a greater or lesser harmony of the rows of

* In the numerous skulls I have examined, there occurred but a single exception. The progress of the closure of the sutures seems to me to differ generally according to the form of the long or short skulls.

teeth. Such a condition facilitates the movements in a forward direction; whilst in skulls, in which the sockets are deep and narrow, the motion is more vertical. I am fully aware that this explanation is not very satisfactory, and I ask myself whether prognathism is not rather the expression of a relapse into the animal form."

(Thus far Pruner-Bey. On our part we have no doubt the latter explanation is the correct. Everything is in harmony in an organism, and we might as well say, the socket and the head of the bone must be flat because the upper jaw projects and the lower jaw is long, as to assume the reverse. Moreover, carnivora whose jaws move only in a perpendicular direction, possess very elliptical articulating heads of the lower jaw.)

It is undeniable that the sudden metamorphosis which at the time of puberty takes place in the Negro, is not only intimately connected with psychical development, but is a repetition of the phenomena occurring in the anthropoid apes. In them also the skull presents, until the second dentition, a remarkable resemblance to the human skull, the cerebral portion being arched and the jaws but little projecting. From that time the cerebral skull remains stationary, the internal capacity no way increases; the ridges and crests only are developed together with the muzzle, which projects from under the cranium until it acquires the form seen in old apes. And with this the mental development proceeds *pari passu.* Young orangs and chimpanzees are good-natured, amiable, intelligent beings, very apt to learn and become civilised. After the transformation they are obstinate savage beasts, incapable of any improvement.

And so it is with the Negro. The Negro-child is not, as regards the intellectual capacities, behind the white child. All observers agree that they are as droll in their games, as docile and as intelligent as white children. Where their education is attended to, and where they are not, as in the American Slave States, intentionally brought up like cattle, it is found that the Negro children in the schools, not only equal but even surpass the white children in docility and apprehension. But no sooner do they reach the fatal period of puberty than, with the closure

of the sutures and the projection of the jaws, the same process takes place as in the ape. The intellectual faculties remain stationary, and the individual—as well as the race—is incapable of any further progress.

The grown up Negro partakes, as regards his intellectual faculties, of the nature of the child, the female, and the senile White. He manifests a propensity to pleasure, music, dancing, physical enjoyments, and imitation, while his inconstancy of impressions and all the feelings are those of the child. Like the child, the Negro has no soaring imagination, but he peoples surrounding nature, and endows even lifeless things with human or supernatural powers. He makes himself a Fetish of a piece of wood, and believes that the ape remains dumb lest he should be compelled to work. The general rule of the slaveholder is, that slaves must be treated like neglected and badly brought up children. The Negro resembles the female in his love to children, his family, and his cabin; he resembles the old man in his indolence, apathy, and his obstinacy. Temperate in common things, the Negro becomes intemperate if not kept within certain bounds. He knows not steady work, cares little for the future; but his great imitative instinct enables him to become a skilful workman and artistic imitator. In his native country the Negro is shepherd or agriculturist; some tribes understand working metals; others carry on trade, not without cunning. Some tribes have founded states, possessing a peculiar organisation; but, as to the rest, we may boldly assert that the whole race has, neither in the past nor in the present, performed anything tending to the progress of humanity or worthy of preservation. As a proof in favour of the artistic and scientific capacity of the Negro, we find cited in nearly all works the instance of Mr. Lille Geoffroy of Martinique, an engineer and mathematician and corresponding member of the French Academy. The fact is, that the mathematical performances of the above gentleman were of such a nature that, had he been born in Germany of white parents, he might, perhaps, have been qualified to be mathematical teacher in a middle-class school, or engineer at a railway; but having been born in Martinique of coloured

parents, he shone like a one-eyed man among the totally blind. M. Lille Geoffroy, besides, was not a pure Negro, but a Mulatto.

Having thus, in our investigation regarding the differences between Negro and White, shown that there are certain constant and easily detected distinctive characters; and having further seen that the differences are in the Negro mostly reducible to an animal or simious resemblance, there arise now two important questions to be discussed.

The first question refers to the *permanence of the differences.* Is it possible that these may become obliterated by any influences in nature, that is to say, without an intermixture of races, so that the Negro may by elevating influences become metamorphosed into a White, or the White by depressing causes be transformed into a Negro?

The second question refers to *animal resemblance.* Are we able to point out the gradations which bridge over the gulf which still exists between the Negro and the ape, and follow them step by step from the anthropoid ape to the Negro, and from the Negro to the white man?

As regards the first question, I shall have an opportunity of discussing it in connection with other phenomena, which will prove that in the various races there is an immanent fixed character, which by external influences is liable to change with certain limits only. As far as our observations extend, we are unable to say that the changes have essentially altered the character. The Egyptian monuments, which show us the Negro as he was thousands of years ago, contemporaneous, probably, with the Biblical Adam, contain excellent representations of the present Negro; and yet the black race has since that time existed in that country by the side of another type—the genuine Egyptian, which has also remained unchanged. With the exception of the tanning of the skin, the white man in Africa never exhibits an approach to the Negro-type. Again, in America, where the black race has for some time been acclimatised, we find that a somewhat lighter colour in the North is the only effect which the climate has produced in more than a hundred years. As far as we can trace, neither these nor other races have undergone greater

changes than other species of animals transplanted to other regions, and must, therefore, according to principles at present prevalent, be looked upon as different species with permanent types. The case is altered when viewed from a higher stand-point, as we shall show in the sequel.

With regard to the second question, an answer resting upon satisfactory observations is as yet impossible.

It is only a few years since the gorilla, of whose existence no one knew, was discovered in the forests of Western Africa. This is, as regards the form of the hands and feet, the most anthropoid among the three great tailless apes; whilst as regards the cranium and brain, it stands lower than the orang and the chimpanzee. The possibility of finding apes which, as regards cerebral and cranial structure, approach man as the gorilla in the structure of the limbs, cannot be denied, but in the absence of the fact it would be foolish to form any conclusions. It is less probable that human races will be found which approach the ape more than the lowest existing human races. The globe has been too much explored to countenance such hopes. The desire of society drives the savage from his hiding places, into which the ape retreats. The ape avoids discovery, man seeks it.

There may, however, have existed *intermediate forms, which in the lapse of time have become extinct.* We shall have to speak on this point when treating of petrifactions, the fossil man, and the primitive condition of the human race, which reaches further back than history, tradition, and mythology. This much we may here observe, that fossil remains of monkeys have been found, which at first were considered as belonging to man; and that, on the other hand, a cranium has been found in the Neander-Valley near Düsseldorf, which has more of the simian type than any other known race-skull. But though this is at present merely an indication, we may hope that other discoveries will be made, the more so as it is only within the last few years that Europe has been well explored.

Where the normal form leaves us in the lurch as regards our investigations, we have a right to avail ourselves of abnormal forms, where we may reap a rich harvest. I do not hesitate to uphold against Bischoff and Wagner, and even against Johannes

Müller, that microcephali and born idiots present as perfect a series from man to the ape as may be wished for; and I consider it my duty here to make an addition to a previous statement concerning the cerebral structure of these unfortunates.

I shall keep, with reference to the skull, to the description by Theile of a twenty-six year old idiot, whilst as regards the psychical phenomena, the classical treatise of Leubuscher, on the so-called Aztecs, furnishes us with excellent materials. The drawing of the skull of an idiot I take from Owen, as the base is also given, agrees in all but a few details with that given by Theile of his "ape-man". I have compared about twenty cases of congenital idiocy, which must not be confounded with cretinism, and I find the following results.

This congenital idiocy is manifestly an arrested brain development chiefly affecting the anterior portion. The form of the cranium adapts itself to that of the arrested brain. The development of such individuals proceeds very slowly, they learn to walk only in the fifth or sixth year, their brothers and sisters are frequently healthy, and so are the parents, though perhaps not distinguished by great intellectuality. In some cases, however, there are in the same family besides healthy also several idiotic children, the malformation being in such cases due to some hidden cause. These idiots are frequently, though not always, dwarfs like the Aztecs. The stooping walk, with their curved knees, not unlike the walk of the ape, makes them appear less tall than they really are. Among the adult idiots, of whom we possess a minute description, some are of average size, as the two Johns examined by J. Müller, and the two idiots of Göttingen and Jena described by Wagner and Theile. Such unfortunates usually die early. Of twenty cases, however, which I noticed, eight reached the twentieth year—a proportion not very unfavourable.

The impression produced by these individuals is decidedly simious, so that the authorities even describe it as such. The arms seem disproportionately long, the legs short and weak. The head is that of the ape; the skull cap is covered with thick woolly hair; the forehead nearly absent; the eyes stare from projecting orbital margins; the nostrils are wide; the

lower portion of the face muzzle-shaped ; the teeth obliquely set, frequently more oblique than should be, owing to the large size of the tongue.

Fig. 68. Negro skull, side view.

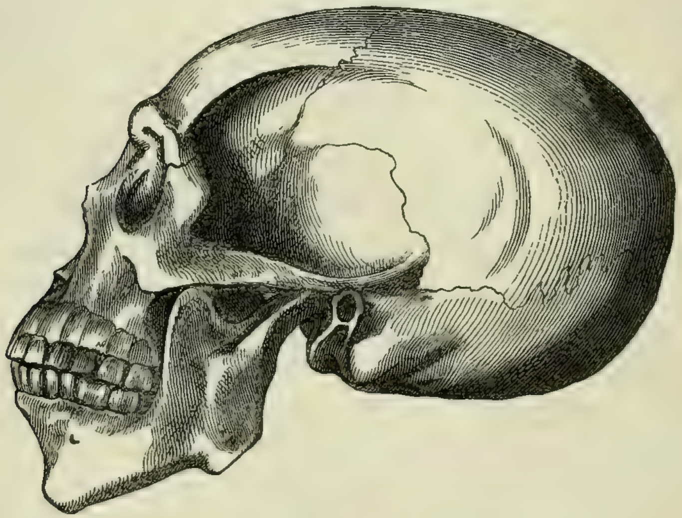
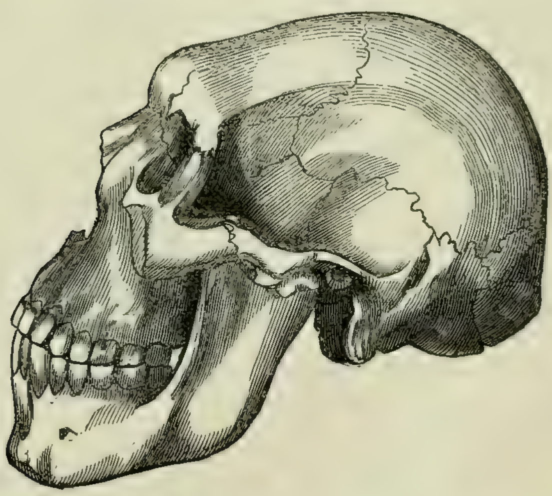


Fig. 69. Idiot skull, side view.



As regards the head particularly, it is disproportionately small in comparison with the body, the diminution chiefly affecting the cranium proper. Viewed in profile, the face occupies as large a space as the cranium. The large osseous pad above the root of the nose, the projecting jaws, the facial

angle of about 53-56 deg.; all these characters are decidedly simious. When viewed from below, the large occipital foramen situated farther back, the long parabolic palate, the

Fig. 70. Kaffir skull, base.

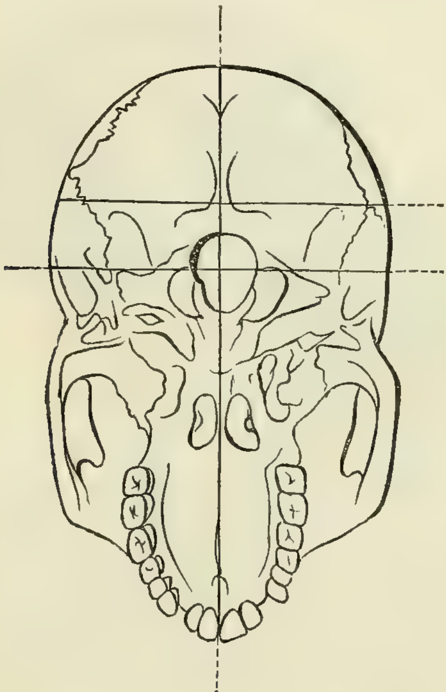
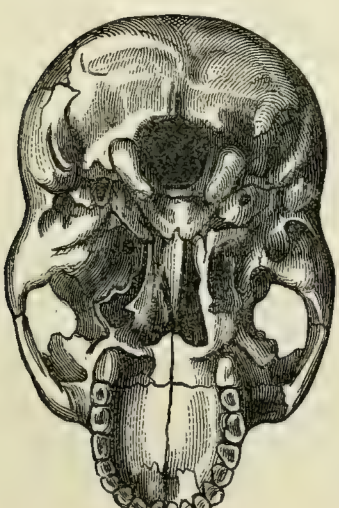
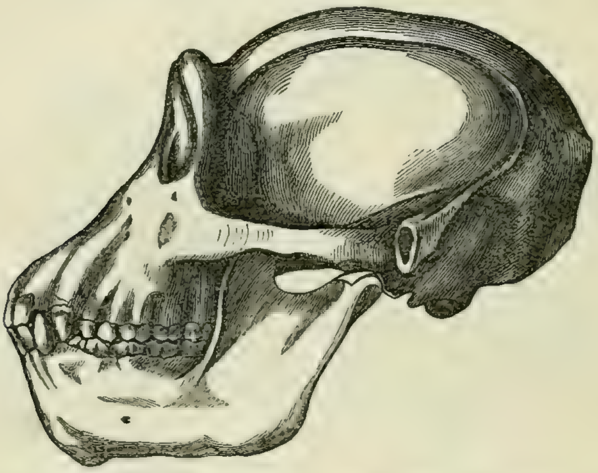


Fig. 71. Idiot skull, base.



open basilar suture, as well as the traces (in Owen's skull) of the intermaxillary suture, all these strike us at the first glance as animal characters.

Fig. 72. Chimpanzee skull, side view.



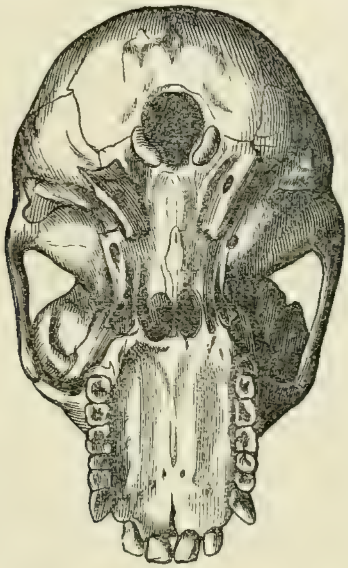
We need only place the skulls of the Negro, chimpanzee and idiot side by side, to show that the idiot holds in every respect an intermediate place between them. The only human characters which the idiot shows in his skull are the gapless serried teeth, and the somewhat projecting chin. The closure of the sutures must by no means be considered as the cause of the arrested cerebral development. In most old idiots the sutures of the upper surface are still movable, those on the sides are frequently closed, whilst at the base they are open as in the ape. The occiput is sometimes square, at times round, but very large compared to the forehead; the internal processes of the skull bear so far an infantile character, from their being rounded, never sharply angular.

We may, therefore, summarise the idiotic forms by stating, that in their brains and skulls the resemblance to the human standard has been diminished by the arrested development of the anterior cerebral lobes, and that only the secondary human character, the serried set of teeth and the projecting chin, have been preserved. If a fossil microcephalic skull were found, without a lower jaw and an upper row of teeth, *every naturalist**

* Query.—Editor.

would at once declare it to be the cranium of an ape, as in such a mutilated skull there would not be found the least characteristic mark which would justify an opposite inference.

Fig. 73. Chimpanzee skull, viewed from below.



We possess the measurements of the two so-called Aztecs—the Mulatto dwarfs; the boy then being about sixteen or seventeen, the girl thirteen to fourteen years old. I have calculated these measurements in the same way as those given of the Negro and European, and having compared them with two anthropoid apes, the chimpanzee and the orang, obtained the following values. The proportion of the length is:—

	Chimpanzee.		Orang.		Aztecs.	
	Old.	Young.	Old	Young.	Boy.	Girl.
Of the vertebral column to that of the arm = 100...	136·5	163·5	158·5	167·7	119·7	115·1
Of the vertebral column to that of the leg = 100...	98·8	115·2	90·4	96·7	122·8	115·3
Of the upper arm to that of the forearm = 100...	93	85·7	102	99	66·7	67·7
Of the upper arm to that of the hand = 100......	77·5	87	78·1	82	52·8	62·5
Of the thigh to that of the leg = 100	76·5	78·9	81·8	81·4	102·5	108·1
Of the thigh to that of the foot = 100............	74·2	76·3	97·5	109·3	50	48·7.
Of the arm to that of the leg = 100	72·4	70·6	57	57·6	102·5	104·4

The human character of the Aztecs is clearly shown by the proportional length of the vertebral column to that of the limbs in general, as well as from the relative proportions of the limbs to each other; the arm is proportionally shorter, the leg longer. Even in its parts the arm exhibits the human type, not so the leg. The thigh is remarkably small compared with the leg, the length of which exceeds that of the anthropoid, and resembles that of the inferior apes. The same proportion which, from the predominance of the cerebellum, almost places the idiot among the apes, obtains also here as regards the shortness of the thigh and the length of the leg.

Here, therefore, we find human and animal character so intermixed, that they might be taken as the results of a hybrid production.

Let us now cast a glance at the vital phenomena of these miserable beings. There are scarcely any sexual manifestations, the parts remaining in the infantile condition; still there are some idiots with normal generative organs. The movements are rapid but unsteady, the walk is tripping. Many of them never learn properly to use their hands. There is in them a restless activity; their attention is easily excited and as quickly obliterated; memory is defective; they are fond of play, but cannot share the amusements of other children, as they are unable to learn them; they are tolerated like domestic animals. Most of them manifest their wants by shrill sounds, which their attendants understand, just as the hunter distinguishes the cries of animals and the gestures of his dogs. Most of them cannot acquire articulate language. The Aztecs pronounced some few words they had learned. Müller's microcephalus, in whom the arrest of development does not appear to have been so decided as in most others, could pronounce some articulate words, and even simple sentences, such as "*Koppe dute weh!*" (My head aches.)

Leubuscher says of the Aztecs:—"They possess memory for such things as greatly excited their attention, for persons who have been long about them. When I measured them the boy recollected earlier proceedings of this kind. . . . After the lapse of eight days he well recollected the previous process, so

that on my questioning him what I had done, he described the lines round his head. But having interrupted my visits for several days he had forgotten me and all the rest, as had also the girl. The extent of their intellectual capacity does not surpass that of an eighteen months' child, and, may be, falls below it. What we are accustomed to call ideas they probably do not possess, as this degree of intellectual development can only be formed upon the basis of individual self-consciousness."

R. Wagner is of opinion that a minute analysis of the psychical phenomena in various idiots might yield important results as regards intellectual activity in general. There is no doubt about this, nor that some of these idiots may, by careful training, be raised in the intellectual scale. This much results, however, from the known facts, that the intellectual capacity is closely connected with the cranial and cerebral structure, and that it never reached a stage admitting of a well articulated language. Most of these idiots are unable to articulate words, some few succeed in pronouncing simple sentences. But so do the parrot and the raven, which animals too, both by tone and pronunciation, render their words significant. A domestic animal can, like the idiot, be trained to cleanliness, in this respect they are therefore equal. There is no trace of such decided human characters, as ideas, a higher intelligence, and abstraction—not even of such primitive notions of good and evil, nor of those original moral qualities as induce some modern French authorities to claim for man a separate kingdom. In many respects the idiots stand below the animal: they are more helpless than the latter, are unable to procure food for themselves, and to preserve their life without assistance. Their whole appearance is simious. The deficient forehead, the protruding, glossy, rolling eyes, the projecting muzzle, the stooping posture, the long arms (Göttingen idiot) and short legs, the minute analogies in the cranial and cerebral structure, the restlessness, the spasmodic twitches, the shrillness of the notes of pleasure or anger,—who does not here detect the ape?

There are no doubt individual human characters, to which I add the distribution of the hair, the form of the hands and

feet—but we have not asserted that the microcephalus is *actually* an ape; only that, if these few characters which manifest the human type were wanting, nothing would remain to distinguish the idiot from the ape. When then Wagner from these few characters infers "that the human type is manifested in *all* corporeal organs of microcephali," he is "running a-muck" against scientifically demonstrated facts. There is here undoubtedly a mixture of human and simious character, the latter being produced by an arrested development of the fœtus *in utero*, forming thus an intermediate stage between ape and man, produced by the progress of the laws of the development of human genus. If now it be possible that man by arrest of development may approximate the ape, the formative law must be the same for both; and so we cannot deny the possibility that just as man may by arrest of development sink down to the ape, so may the ape by a progressive development approximate to man.

LECTURE VIII.

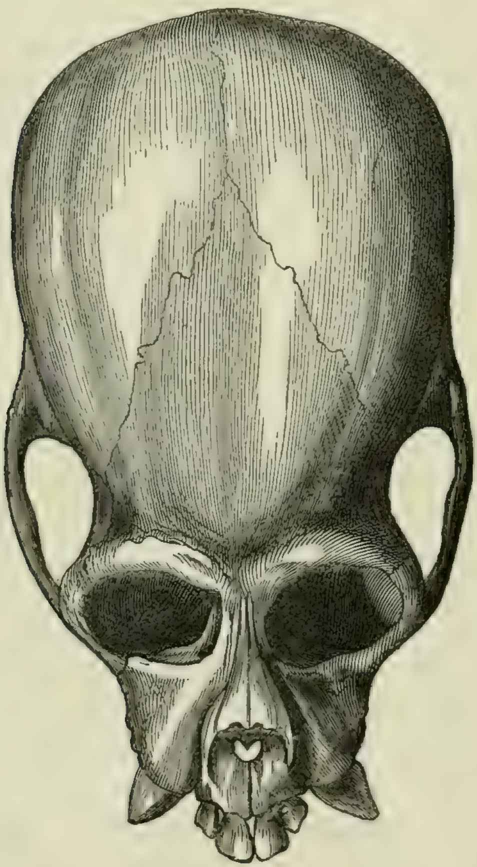
Comparative Examination of two species of monkey, *Cebus albifrons* and *Cebus apella*.—Skull and Brain.—Other parts.—Affinities in Nature.—Families.—Definition of Species, Variety, and Race.—Inbreeding of Races and Species.—Mutability of Species.—Classification of Mankind.—Relation to the Ape.—The Human Kingdom according to Geoffroy Saint-Hilaire and Quatrefages.—Objections.

Gentlemen,—It has ever been the custom to mete with a different measure according to the object to be measured and the disposition of the measurer. Sooner or later, however, the fraud, even if it be a pious fraud, is detected and refuted. This is more readily effected in science, which acknowledges no other authority but its own laws resting upon well observed facts. My object in this lecture is to apply to apes the same method which we have followed as regards man. We shall select for this purpose two species of apes generally acknowledged as such, and shall examine their distinctive characters. As already observed in a previous lecture, it is perfectly indifferent what species are selected, as, considering the great analogy in the physical structure of man and ape, the characters of the same parts are to be considered. Had we descended to the lower orders and classes of the animal kingdom, it might have been objected that the great modifications in structure would require the application of different principles. This does not apply to the ape, and if it can be shown that such and such characters force us to assume different species in apes, the same characters must lead to the assumption of different species in the human group.

By mere accident, and not by choice, I have come into possession of two species of the American Cebus (Rollaffen). This genus is very numerous; it is spread over the whole South

American continent inhabited by simious tribes, and exhibits such a variety in form, that it is difficult to distinguish the different species merely by their external appearance. The *cebus* presents in this respect difficulties not unlike those attending the investigation of mankind, since every species exhibits such a diversity in form, that by some they are considered

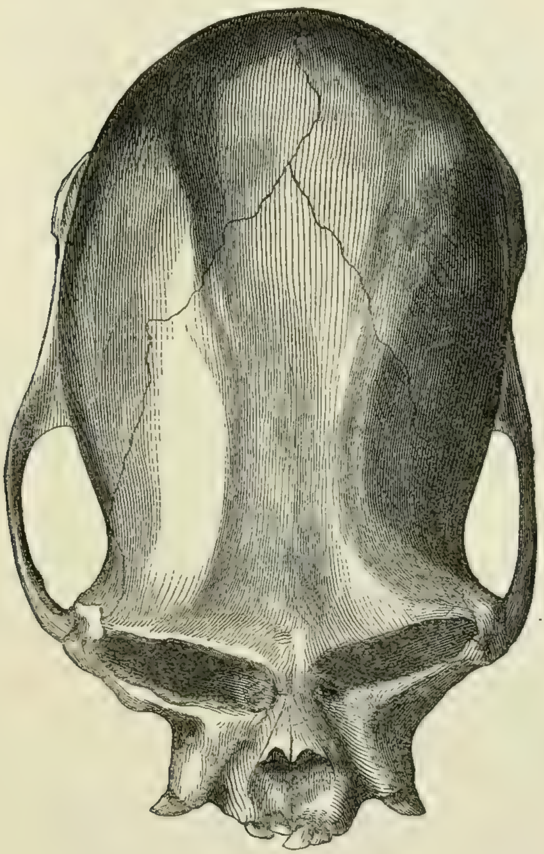
Fig. 74. Skull of the brown Sajou (*Cebus apella*), top view.



as separate species, by others as varieties or races. It is, however, our object not only to ascertain whether the *cebus albifrons* (Weisstirnige Rollaffe) is only a variety of the common Capuchin ape, or a separate species; but also to discover by what characters this species may be distinguished from the common brown sajou (*cebus apella*). That they belong to different species is undoubted. The brown and the white

fronted cebus belong to two different divisions of the *genus cebus*. The first, according to Girbel, belongs to the species possessing five ribless lumbar vertebræ, a compact structure, a thick globular head, powerful teeth, large canines, short limbs and tail; whilst the white fronted Capuchin ape belongs to the species possessing six ribless lumbar vertebræ, small

Fig. 75. Skull of the *Cebus albifrons*, top view.



canine teeth, and a slender structure. We thus find here more than a simple specific difference, so that some naturalists felt justified in establishing two sub-genera; nevertheless I selected these two species simply because in the Geneva Collection I found two male skulls of the same age and size.

The Roll-apes (*Cebus*) possess a long hairy roll-tail. The

body is long and slender, the limbs powerful, the eyes small, the muzzle short, the head roundish, so that among all American apes they most resemble man—a resemblance which is increased by their having around the face tufts of hair resembling whiskers and beard. It is only the flat nose which mars the human likeness. The four hands are equally developed, the hand itself is long and narrow, but the thumb of the posterior hand is longer and stronger than that of the anterior. The dental system consists of four chisel-shaped incisors, two large projecting and somewhat curved canine teeth, presenting deep grooves on the inner side, and twelve molars in each jaw, so that the number of teeth amounts to thirty-six. The molars diminish in breadth backwards, so that the hindmost is small and almost rudimentary compared with the other.

We shall first examine the external aspect. The brown Cebus reaches to the size of a cat, and presents in middle age a yellowish brown colour, somewhat brighter on the belly, whilst the vertex, the cheeks, forearm, hands and legs are dark brown or black. The face has a tinge of violet, the eyebrows are long, on the short forehead is brown hair so stiff that the animal seems on a side view to be provided with two horns. The ear is covered with long soft hair; the beard is of a paler shade.

The *Cebus albifrons* was met with by Humboldt near the cataracts of the Orinoco, and is by most zoologists considered a mere variety of the Capuchin monkey. The face is bluish grey, forehead and eyemargins white, the body dark grey on the back, of a lighter shade on the thorax and belly, the limbs yellowish-white, the vertex brownish-grey, so that the animal seems to wear a cap on the head. The ears are very hairy. The common Capuchin monkey, to which this variety is said to belong, greatly resembles the Cebus as regards colour.

The skull presents in both species exactly the same shape. Viewed from above, we see an elongated oval, having its greatest breadth in the posterior part corresponding to the large occipital foramen. We must here certainly make allowance for the projection of the mastoid processes, the upper brims of which are continuations of those of the zygomatic arches.

I shall presently give the exact measurements, here I shall only notice a few characters.

On viewing the skull from above, that of the brown Cebus is distinguished by the rising of the temporal fossa above the

Fig. 76. Skull of *Cebus apella,* side view.

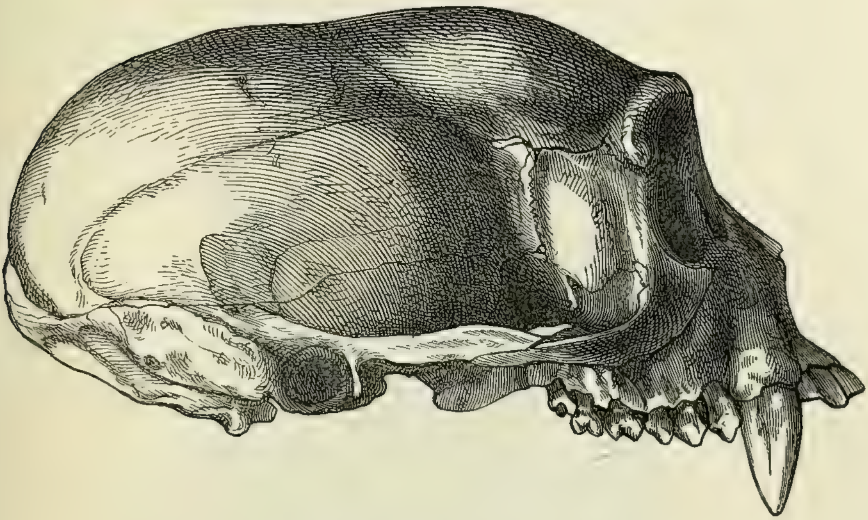
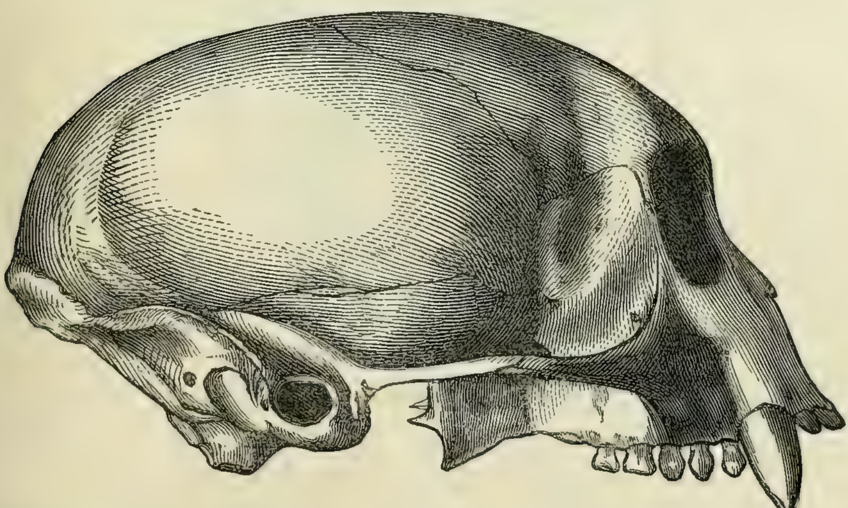


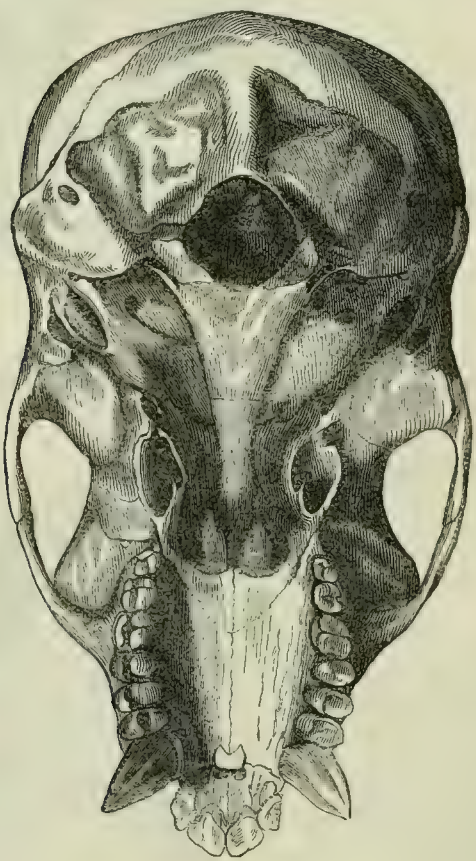
Fig. 77. Skull of *Cebus albifrons,* side view.



margin of the temporal line, passing behind the whole length of the superior orbital brim, and producing in the middle of the forehead a depression which causes the orbital ridge to

project. The temporal line is thereby less distinct and runs nearly parallel with the central line, until with a sudden curve it reaches the point of junction between the lambdoid and temporo-occipital sutures. In the white-fronted Cebus, on the contrary, the temporal line proceeds from about the middle of the superior orbital margin, and rises in a curve towards the central line, so that between the two temporal lines there

Fig. 78. Base of skull of the Brown Cebus.

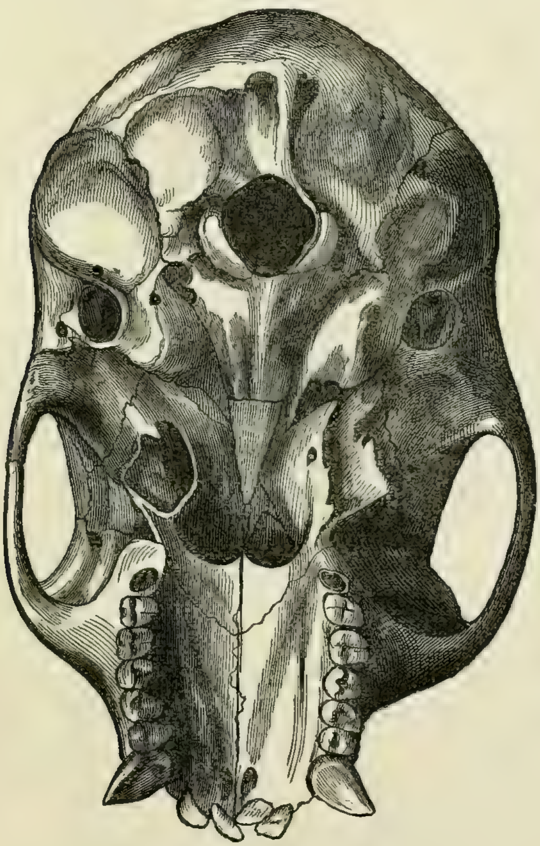


remains only a space of a centimetre, it then turns abruptly to reach the same point as in the former species. In this way there is formed on the forehead a triangular space, smooth and somewhat arched, differing considerably from the depressed

forehead of the brown Cebus. As regards the rest, the shape of the cranial bones and the course of the sutures is the same in both.

On viewing the skull from the side, scarcely any differences are noticed excepting those mentioned. The posterior projection of the temporal bone, which, so to speak, continues

Fig. 79. Skull of *Cebus albifrons*, base.



the zygomatic process, is less prominent in the brown Cebus, but shows behind it a deeper depression than in the *albifrons*. The zygomatic arch is higher and thinner in the brown Cebus; in the *albifrons* rounder and thicker. The skull of the *albifrons* is more equally arched, whilst it is somewhat depressed in the middle in the brown Cebus; in the latter the occipital squama is nearly horizontal, in the former it inclines inwards.

On examining the skulls in front, the orbits of the brown Cebus appear larger and wider; in the *albifrons* they are rounder, smaller, and the margins thicker and more massive. The maxillary region, specially around the nose, appears narrower in the brown Cebus, and rather compressed behind the projecting root of the canine tooth, which has a downward direction; whilst in the *albifrons* it is oblique, thicker, but less long and sharp. The two characteristic grooves on the inner side of the canine tooth are in the brown Cebus deeper than in the other species.

On viewing the base of the skull (see figs. 78, 79), it seems in the *albifrons* on the whole broader, more massive, and better developed in all its parts than in the brown Cebus, in which the palate is longer and narrower, the front teeth more projecting, and the zygomatic arch more curved. No difference is seen in the arrangement or form of the molar teeth, but the petrous bones are more prominent in the *albifrons*.

TABLE OF MEASUREMENTS OF THE CEBUS IN MILLIMETERS.

		Albifrons.	Apella.
1	Longitudinal circumference from posterior margin of occipital foramen magnum to alveolar margin -	150	148
2	From anterior margin of occipital foramen to nasal suture - - - - - -	54	52
3	From posterior brim of occipital foramen to alveolar margin - - - - - -	72·5	73
4	From anterior brim of occipital foramen to alveolar margin - - - - - -	60·5	60
5	From anterior brim of occipital foramen to basilar suture - - - - - -	15	13
6	From anterior brim of occipital foramen to posterior margin of palate - - - - -	31	32
7	Length of palate - - - - -	29	28
8	Greatest length of skull from alveolar margin to occiput - - - - - -	90	91·5
9	Length from nasal suture to occiput - -	77	74
10	Greatest breadth of a vertical plane through the centre of the occipital foramen - - -	54	51
11	Transverse diameter on the posterior margin of the zygomatic arch - - - - -	51	50
12	Transverse diameter on the lowest point of the temporal fossa - - - - - -	40	41
13	Distance between the zygomatic arches - -	62	57
14	Distance between the inner margins of the external auditories - - - - - -	31	32
15	Breadth of palate - - - - -	19	18
16	Greatest diameter passing between the eyes -	42	44
17	Breadth of the septum - - - -	5	5
18	Height of nasal aperture - - - -	17	11

You perceive from these details, that the skulls of these two species, which some would distinguish as two sub-genera, are much more like each other than the skulls of most human races and even tribes. We should, in fact, detect much wider differences between the dolichocephalous skull of a Swede and the brachycephalous cranium of a Russian; between that of a Hottentot or an Austral Negro; between that of a Irokese and a Botocudo; though all these various tribes are all included in one race. We are even able to point out greater differences between individuals belonging to the same stock, and it would be easy for me to show by the juxtaposition of the skulls of a Graubünden, Zurich, or Bernese man, that these skulls of Swiss tribes differ more from each other than those of the apes we have described. Even an inexperienced individual would find it easier to separate these human skulls in a collection than to assign the above ape-skulls to different species.

No skeletons of the two species of apes are at my disposal, I cannot therefore furnish you with the measurements of the limbs and other parts. According to Giebel the skeleton of the Cebus is distinguished by greater solidity, that of the large Capuchin monkey being more elegant and slender. This is seen in the ribs, the lumbar vertebræ, pelvis, and sternum, in short, in all parts of the skeleton. Besides this the Cebus has only five lumbar and twenty-four caudal vertebræ, whilst the Capuchin has six lumbar and twenty-five caudal vertebræ, corresponding with the greater length of the tail.

Having no internal parts at hand, I give two brains from Gratiolet's well known treatise. These brains belong to a simian group of the old world, which has by zoologists been divided into various subgenera.

The *Macacus silenus*, which inhabits Ceylon, has a short tail, whilst the *Cercopithecus æthiops*, originally probably a native of Senegambia, has a very long tail. I have given also side views of the brains, and have in the first figure turned back the operculum of the posterior lobe, in order to show the transition gyri beneath it. I shall not enter into any details, as even a superficial inspection shows that the form of the brain and its

P 2

parts, the arrangement of the lobes, of the convolutions and their sulci are so similar, as to amount only to individual differences. In the cercopithecus the margins of the gyri are a little more notched and arched, so that there exists an indica-

Fig. 80. Brain of Wanderoo (*Macacus Silenus*), top view.

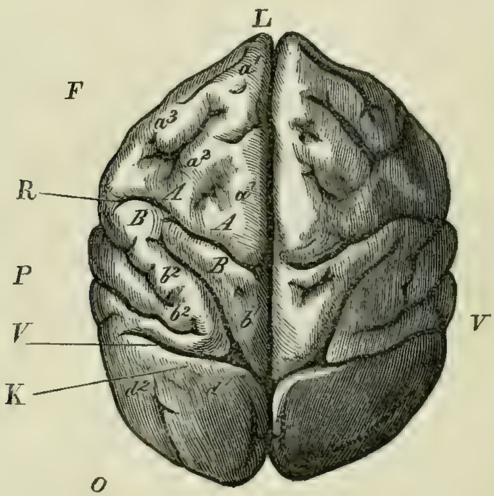
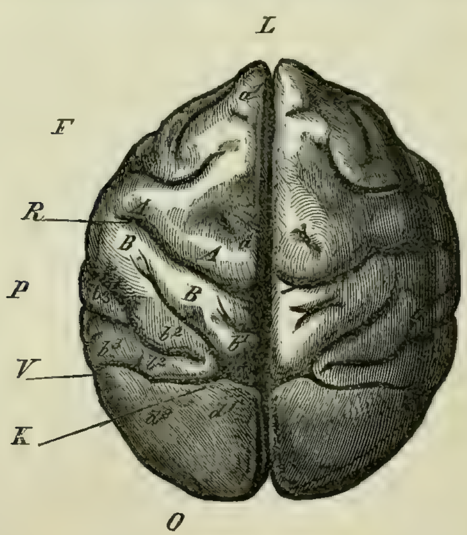


Fig. 81. *Cercopithecus æthiops*, top view (The Mangabey).



tion of greater complexity in the convolutions, which is further developed in other apes. Apart from this the differences are

so slight, that they might in so delicate an organ be ascribed more or less to a difference in observation. Now compare with these the brains of the Hottentot Venus and the German as given before. We may leave the inference to common sense.

Fig. 82. Brain of *Macacus Silenus,* side view.

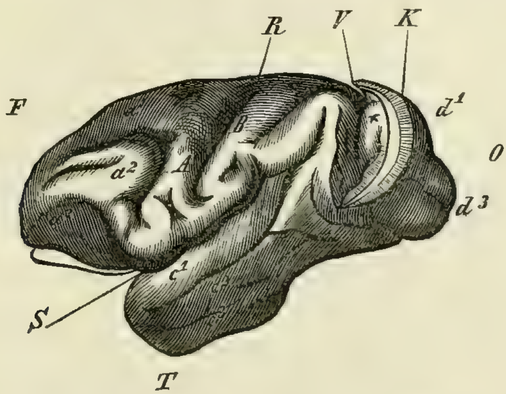
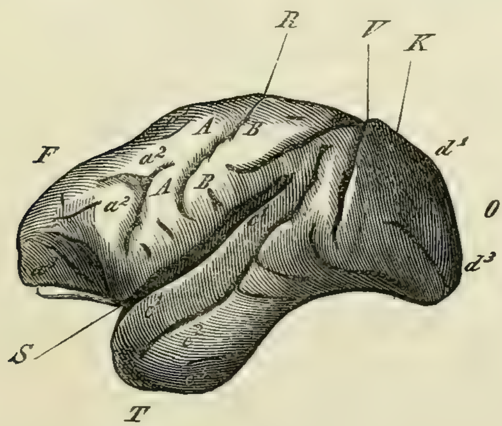


Fig. 83. Brain of *Cercopithecus æthiops,* side view.



The description of the figs. 80-83 is the same as in the preceding brain figures.

It is unnecessary to say more on this subject. Any person may select any two well characterised races of mankind, and having by comparison formed a scheme, let him proceed in the same way in the comparison of two well marked species of apes. The unprejudiced observer cannot fail to find, as we have done, that the sum of the differences between two species of apes, is in no case greater, and in many cases much less

than those obtaining between two races of mankind, and he will arrive at the conclusion that the races of mankind must either be considered as different species, or the species of apes must be designated races. But what is to become of systematic zoology, if the long and short-tailed species of apes, differing so much in external form that they have even been divided into genera, are to constitute only varieties or races? All systematic natural history would go to ruin, and all simiadæ, from the lowest ouistiti up to the gorilla, would be fused into one whirlpool, which would swallow up man and all his races.

But we must now pause before proceeding further. You may justly complain that I have as yet given no definition of species or genus, of race or variety, and that, therefore, you are perfectly indifferent, whether the systemisers look upon wolf and dog, ass and horse, Negro and White, as so many genera, species, races or varieties, provided the analogies or differences are so well established as to enable us to distinguish the respective animals.

In some respects it might matter very little whether Negro and Mongol are placed in the same chest labelled "Man;" for the classification of the animal kingdom is nothing but an arrangement of animals in chests, drawers, and pigeon-holes. But the question acquires importance if by the expression species we understand a permanent type with fixed limits, which may admit of an ideal but not of a material relation to other species. It is therefore of importance for us to establish whether any particular form we meet with constitutes an independant species or not.

We can at first only examine such animal forms individually; but the results we may obtain are insufficient, as each individual has its own more or less marked peculiarity. We are therefore necessarily led, on the one hand, to search for the sum of analogies, and on the other, for the differences, and to infer from the results the degrees of affinity subsisting between the individual beings.

Nature points out such affinities. Family bonds exist as much in the animal kingdom as in the human species, and are frequently in the former stronger and more lasting than in the

latter. In most cases, it is true, this family life in animals extends only to one generation; for when the young are able to support themselves, they separate from the parents, and the family connection is severed. Every year, or even a shorter period, brings a new family, which again separates, to become perhaps the heads of another family. It, however, occasionally happens, as is the case with bears, that the eldest of the young remains at home, being appointed nurse to the younger generation, and is severely chastised by the mother if it neglects any of its duties. Wherever the families remain together, the society enlarges and a division of labour obtains, so that the existence of the individual frequently depends on family life. The herds of deer, antelopes, and buffaloes are probably only the members of one family grown up together and led by the oldest member of the herd. In such societies the family bonds are slender enough; but it is different in such social animals as bees, ants, etc., in which the individuals possess different forms and organisations, according to the part they play in their domestic economy.

The development of the young presents a series of conditions greatly differing from those of advanced age, and a very close examination is requisite for becoming convinced that an animal in the larval state is transformed into a subsequent mature form. These deviations are so great, that up to Cuvier's time certain animals were classified when young as mollusca, and in the adult state among the articulata. There are also the sexual differences. We have seen that in man the physical differences between male and female are in every respect greater than the differences existing between individuals of the same sex in different races; and we also know that in many animals the sexual differences are so great, that the closest examination is requisite to establish their relations to each other.

In the lower animals we observe a series of development stages, which only terminate after several generations, so that not the child (so to speak) but the grandchild resembles the parents; and there exist, probably, more complicated family connections, by which individuals seem to return to the original form by a roundabout way.

The range of divergence is as yet far from being exhausted. Every one knows that children of the same parents, though possessing a family likeness, are never perfectly alike, that even twins or animals of the same litter still exhibit peculiarities which enable us to distinguish them. The range may be wide without transgressing the limits which separate the normal from the abnormal structure, and this is specially the case when the parents themselves occupy the limits of the normal structure. Reserving the details for another occasion, I would here merely draw your attention to the fact that such peculiarities may be transmitted through several generations. Thus there are families in which supernumerary or webbed fingers have been transmitted through several generations, until frequent intermixture with normally formed individuals has led to the obliteration of such abnormities.

To characterise the family the naturalist must study all these possible deviations, and it is clear that in the absence of direct observation he is liable to many errors. Natural history furnishes many instances of the separation of parents and offspring, young and old, male and female, until direct observation clearly established their relationship.

Having now arrived at the first stage, namely, the recognition of a certain type belonging to all individuals derived from a certain stock, we must proceed further and acknowledge that this type may also belong to a number of individuals, which, as far as we can trace, are not descended from the selfsame stock. Thus, for instance, taking into account the present condition of the globe, we cannot understand how the trout north of the Alps can belong to the same stock as those south of the Alps, separated as they ever have been by insurmountable mountains; or how the chamois of the Pyrenees can be directly related to those of the Alps, separated as they are by plains equally inaccessible to the mountain animals. And yet the sum of resemblances is so great that these animals might unhesitatingly be included in the same stock if their descent were not known to us. We recognise a type with certain definite characters which we term species, and which we might define as follow:—all individuals possessing such

common characters, which mark them as actual or possible descendants from the same parent stock, belong to the same species.

Let us for the present adopt this definition and keep to observation, which, in most cases, is unable to trace actual descent, but must attend to the characters of the individuals. We find in a certain region a type of animals,—a good species, as naturalists would call it,—which is easily recognised; we collect a number of such individuals, we dissect them, we observe their development, compare them so as to obtain a perfect knowledge of the species. The question arises now, is the type we have so closely studied universal and unalterable?

Observation teaches that this question must be answered in the negative. We find almost all naturalists agreeing that species has a wide range, in which the characters of the individuals composing it are changed. In all books and treatises, varieties are mentioned which are subordinate to species. But as regards the term variety, and the notion to be attached to it, its limits and relation to species, the opinions are conflicting; some authors calling that a variety which others term a species. Linnæus defined variety, as any alteration produced by an accidental cause; Geoffroy St. Hilaire terms a variety a simple anomaly which does not obstruct the performance of any function. We may, perhaps, ask what is the limit of this simple deviation; and as no general rule can be given, it will depend on the judgment of the observer what limits he assigns to variety. We find, in point of fact, that each type and each species has, in this respect, its own laws; that a deviation which is insignificant in the one may be great in another. It is, consequently, very difficult to lay down a general definition of variety, the more so as an accidental abnormity may become normal by its permanence. Let us examine this subject. By some accidental influence a short-legged ram is produced in a long-legged flock. This is an accidental abnormity confined to one individual,—the case is an exceptional one, and the naturalist does not look upon this individual as constituting a variety. But this ram has descendants; the local conditions, let us assume, favour the propagation of short-legged sheep

(in the case I have in view it was done by the interference of man). The short legs become numerous, and constitute a large proportion in the number of sheep of that region. We now possess a variety which, by naturalists, is considered the product of local influences. The variety is now described as the short-legged, and in the museums placed side by side with the long-legged sheep; and the name of variety seems the more justifiable, since, among the lambs produced by the short legs, there are always some with longer legs, which seems a relapse into the original type.

In the above case, it was the advantage of the proprietor to possess short-legged sheep unable to surmount the fences. He therefore interfered; he coupled his short-legged ram with his shortest-legged descendants, purged his flock from all the long legs, and thus he obtained, in the course of time, a short legged race, which is now spread over North America. Now, in the course of time the births of long-legged lambs have become rare among the short-legged sheep, and the abnormity has become permanent, so that man has first formed a variety, and finally a race,—for races are defined constant varieties, whose characters are permanently propagated.

What man has done here, nature does everywhere. We may consider every species, with its distinguishing characters, as the product, to a great extent, of the influences acting upon it. Every day in the life of an individual is a struggle for existence. The individuals will be best developed where the struggle is easy. The conditions of life vary for each species; hence each species will best thrive in one or several centres, but will degenerate or become extinct in others. We usually consider *that* the type of a species which is developed under the most favourable conditions; we consider as varieties or races such forms as under less favourable conditions have deviated. The mussels peculiar to the seas of our temperate zone become smaller, and are differently marked at the limits of their region, be it north or south. They miss the conditions requisite for their growth, and are no longer seen. But among the mussels on the German and French coasts there are some which increase in size as they move towards

the north; such are the mussels which find their vital conditions in the arctic sea, in Greenland and Spitzbergen, where they acquire their full development. Among the arctic mussels on the French coast, a particular type has been established, which, having become permanent as an independent race, no mussels are now produced with the size or the markings of the arctic type. The smaller the region tenanted by a certain species, the more defined is its type; the wider the region, the greater the number of races and varieties. That which here interests us most is the inference that the abnormal form, and generally any deviation from any given type, by whatever influences it may have been produced, may, by propagation and transmission, give rise to a variety, and that this variety may, by the constancy of its distinguishing characters, become a race, and be propagated as such.

With regard to propagation, we observe a difference among races, some becoming obliterated in the progress of intermixture with other races; whilst some impart their peculiarities to their descendants for many generations. Every dog-fancier knows that the blood of a Newfoundland dog is almost indestructible,—that one crossing is sufficient to perpetuate some of the characters through many generations. But it is also known that the Newfoundland dog belongs to a race very probably the product of the country where it is found, and of the natural conditions of that country, and that this race may justly be considered as a well-marked species. Those who include all dogs, from the Dingo of Australia to the Polar dog, in one species, will only look upon the Newfoundland dogs as a race which is distinguished above many others by the constancy of its characters.

It is looked upon as characteristic of races or varieties that they admit of crossing, and that their descendants are infinitely prolific. We shall, for the present, consider this axiom as established, though we cannot help observing that the proofs are not complete, and that some results in the breeding of domestic races do not accord with it. This much seems established, that in proportion as races become constant, the difficulty in pairing them increases, and that in the free state

races manifest as much antipathy to each other as so-called species, so that extraordinary circumstances, or the interference of man, is necessary to overcome that antipathy in order to effect the crossing.

Species, according to Linnæus, is the corner-stone upon which systematic natural history rests. Linnæus considers species as an originally created form. Buffon, whose opinions oscillated, taught that all individuals which produce a prolific offspring belong to one species, and according as authors attached more weight to propagation or classification, the agreement in characters, or the production of prolific descendants, became the centre around which the definition turned. Thus Andreas Wagner includes under one species all individuals which produce prolific descendants, without any regard to external characters; so that the same man who assumed hundreds of species of animals, from mere differences in their fur, would at once include wolf, jackal, and the domestic dog, in the same species, if it could be shown that they produce, in crossing, prolific descendants. Agassiz, on the contrary, rejects prolificacy of offspring as a distinguishing mark of species, which he constructs solely from external characters and their relations to surrounding nature.

The real cause of such discrepancies must be sought for in the practical treatment of science, and the tendency attributed to it. The reason why some embrace one, and others a different theory, is that the results are conflicting if you start from any assumed axiom. Allow me to explain this point. We may boldly assert that, among the many thousand species now known, the number of which will, in the course of time, rise to a million, there are not one hundred whose inbreeding has been traced so far as to enable us to assert that they are infinitely prolific; we cannot even in the strictest sense assert this of our domestic animals, and still less of wild animals. As regards, therefore, the great majority of species, as Giebel has proved, propagation is purely hypothetical. You will also observe that, in discussions on the establishment of new species, the faculty of propagation is taken into account. Men dispute about the value or worthlessness of distinctive

characters, and compare these with such as are considered as decisive in similar species; but they never think of instituting experiments in regard to the propagation of the different species; and thus two naturalists, though perfectly agreed about the definition of species, may entertain different opinions as regards the application of the definition, so that one assumes ten different species where the other only sees one species with ten varieties. In living nature, the specific character of propagation might be discoverable; but in extinct animals,—those thousands of species which have disappeared from the surface of the earth and are only known to us from their relics,—such proofs cannot be given; and palæontology would be deprived of a basis if species could only be determined by propagation, and not by distinctive characters.

There can thus be no doubt that practically it is only the distinguishing characters which must guide us; whilst the test of propagation can only be applied to man, the domestic animals, and some others standing next to man. But when we try to combine the distinguishing characters with the results of propagation, we meet with the most glaring contradiction, inasmuch as certain animals produce a fertile progeny, and yet differ far more from each other than those which produce sterile hybrids. Giebel has scientifically demonstrated that the races of dogs which produce a fertile progeny present in size, hair, colour, the structure of the skeleton, the number of toes, the formation of the skull and teeth, much greater differences than the horse and the ass, which produce sterile hybrids. Such, therefore, as consider all dogs as races of one species, must admit that, as regards the distinctive characters, the races of some species may be more remote from each other than species,—an admission which upsets all systematic natural history.

Species has been characterised as a permanent type; and it can easily be shown that such naturalists as assume this immutability theoretically, are practically forced to assume varieties and races. Species has also been spoken of as an original type, something primitive and fundamental; and yet it must be confessed that, in the history of the earth, species

have arisen and have perished like the flowers in summer. Species has further been defined as a collection of individuals who transmit their characters regularly and indefinitely; but it has not been considered that thousands of species have become extinct, some of them even in historical times, specimens of which are only to be seen in our museums. To cite only one instance of this kind, I would mention that the great auk (*Alca impennis*), which formerly inhabited Denmark, and in 1842 still existed in Iceland, is now entirely extinct, so that only some twenty of their skins are preserved in different museums. Species, then, is alterable by external influences, and arises and perishes like individuals.

On more closely examining the definitions of race and species, sanctioned by usage, it may be reduced to an historical basis. We assume races where we know, or think we know, their common origin; we assume species where their origin is hidden in the past. We assume races in domestic animals where, by our interference, we have succeeded in producing varieties. We assume races in mankind, because we believe we have evidence that the differences in form have arisen in historical times. No man would certainly have doubted the specific difference in mankind, if the unity of the human species had not to be defended at any price,—if a tradition had not to be supported in opposition to the plainest facts,—a tradition which has been the more venerated because it runs counter to positive science.

As regards species, then, we hold fast by the principle that the genus *Homo* consists of several species, which deviate from each other as much, if not more, than most *simiadæ*; and if the principles of systematic zoology are to be of any value, they must be as applicable to the human as to the simious species.

With regard to general classification, we distinguish genera, families, orders, classes, provinces, and kingdoms; the latter being the great divisions constituting the animal, the vegetable, and the mineral kingdom, comprehending all existing forms. We shall now examine the relations in which the species of mankind stand to this classification.

That all human races belong to the same genus admits of no doubt. The sum of characters which connect the white with the black, on the one hand, and separate him, on the other, from the most anthropoid ape, are, by the admission of all naturalists, so great, that they determine a separation as a genus and a family. But now opinions diverge. Whilst some would, according to zoological characters, consider the human genus as a family of the simious type; others would consider man as constituting a separate kingdom, of the same value as the vegetable and animal kingdom. Let us shortly examine these theories.

It is undeniable that, in the human and the simious structure, one fundamental plan is perceptible, which is well marked in most parts. The formation of the brain, the structure of the skeleton, the position of the bowels,—all indicate this fundamental plan. But within this fundamental plan, which is as plain as that in the carnivora and ruminants, there occur deviations, such as we have explained in a former lecture; and the question is whether these deviations are sufficiently great to justify a separation from the ape, or whether in the ape family itself there obtain differences as great as between man and ape.

Naturalists distinguish from the apes proper so-called half-apes (*prosimiæ*), which, as regards the form of the limbs and hands, are perfect apes, but are distinguished by form of skull, brain, and teeth. The hands are generally well-developed; only the forefinger of the posterior, and sometimes that of the anterior extremities, is provided with claws, adapted for scratching out the insects from fissures. These deviations would scarcely render a separation necessary, as greater differences in the formation of the hands occur also in European and American apes, in some of which the thumb in the fore extremities is either entirely absent or curtailed to a stump. The differences in the structure of skull, brain, and teeth seem, however, sufficiently important to justify a separation of the *prosimiæ* from the apes proper. The cranium is round and small, the muzzle prominent; the teeth scarcely resemble those of the apes, they are serried, exhibiting no

gap, as seen in most apes; the superior incisors are stunted, the lower projecting nearly horizontally, in short, according to the dental formation, the *prosimiæ* seem to belong to the insectivorous mammalia. Also, with regard to cerebral structure, they approach the insectivora; they possess no posterior lobe, but an olfactory bulb, not possessed by the former; they have, however, like the apes, a Sylvian fissure. The *prosimiæ* are usually considered as a sub-order, from the formation of the limbs, which certainly are simious; but as, despite the resemblance of limbs, insectivora are separated from carnivora, the prosimiæ might also be separated from the ape, and placed among the insectivora. Whilst, therefore, many naturalists look upon the *prosimiæ* as a family of the primates or quadrumana, and others make a sub-order of them, we might, on the ground of their dental and cerebral structure, claim for them a separate order.

The same conditions occur in mankind. The chief differences consist in the structure of the skull, brain, and teeth; whilst the differences in the extremities, though sufficiently characteristic, occupy, as regards importance, only a secondary rank. The great preponderance of the cranium over the facial part, the development of the anterior lobes and the convolutions, the serried teeth, would alone secure for man a position above the apes, such as is assigned to the latter above the *prosimiæ*. When to this is added the peculiar structure of the feet, a distinction which is not obliterated by the prehensile foot of the gorilla, the separation of the human genus from the ape is as justifiable as the establishment of a separate order for the *phocidæ*, which, as regards cerebral and dental structure, belong to the carnivora, but claim a separation on account of the development of their extremities.

Our opinion as regards the classification of mankind is, that it is of the same value as that of the apes, and that both belong to a common type in the series of mammals.

It may be said that no modern author lays such stress as we do upon the zoological differences prevailing among mankind; for the sub-class which Owen would create for it, is, with the material facts of cerebral formation upon which it was founded,

gone the way of all flesh. But recently two Frenchmen, Geoffroy St. Hilaire and Quatrefages, have attempted to determine the position of man, not according to the peculiarities of his organisation, but according to qualities external to the physical organism. I shall offer some observations on this subject after quoting the remarks of the respective authors. Isidore Geoffroy St. Hilaire says: "Sensation and motion alone constitute the animal; and all efforts to render the definition more perfect, by adding other characteristics, only render it less philosophical and correct. The characters, derived from the structure of the animal, at once distinguished from others derived from its qualities, are neither essential nor constant, and can by no means rank with the attributes of sensation and spontaneous motion.

"It is in this way that the chief objection to the establishment of a human kingdom is removed. Let us abandon to the subdivisions of natural history those structural characters by which every being is distinguished. The true knowledge of the great divisions of nature, of provinces and kingdoms, lies in a different sphere. The animal is distinguished from the plant by peculiar faculties, which are obliterated where animality ceases, and it is by virtue of these only that it belongs to a separate kingdom. Even so is man separated from the animal kingdom by his incomparably higher qualities and capacities,—by the intellectual and moral faculties, which are added to sensation and motion; and it is by these that he constitutes the highest division in nature,—the *human empire*, above the animal kingdom.

"The plant," continues Geoffroy, "lives,—the animal lives and feels; man lives, feels, and thinks." In another passage the distinctive character of man is said to consist in "intelligence;" in other sentences, again, it is said, "Moral life is, in the human kingdom, added to vegetative and animal life;" and again, "there may be degrees in the development of the vital, sensitive, and intellectual qualities; but there is nothing intermediate between life and non-life,—feeling and insensibility,—thinking and not thinking." Thus, the animal, according to Geoffroy, does not think,—man alone thinks; the

question is, therefore, disposed of; yet we cannot conceive how so monstrous an assertion can be sustained.

Quatrefages is more cautious. He says, "Shall we find the characters of the human kingdom in the intellectual capacity? Certainly, the comparison of the mental development of man with the rudimentary intelligence of even the most gifted animals, never suggested itself to me. The interval between brute and man is, in this respect, so great that a perfect difference between them was admissible. But this is no longer tenable. The animal does possess intelligence; and though their fundamental capacities are less developed, they nevertheless exist; the animal feels, wills, remembers, deliberates, and the correctness of its judgment seems frequently miraculous; whilst the very errors which the animal commits give evidence that its judgments are not the mere results of a blind and necessary impulse. We, moreover, observe great inequalities in the various groups of animals. Thus, among the vertebrata, we see that birds much excel fishes and reptiles, but are much inferior to mammals. It would, therefore, not be surprising if, among the latter, we were to find some animal possessing a much higher intelligence; this would only be a progress, but no fundamentally new phenomenon.

"What we observe of intelligence in general, applies also to its highest manifestation,—language. Man, it is true, alone possesses articulate language; but two classes of animals possess voice. They, like ourselves, produce tones which express feelings and thoughts, and which are not only understood by individuals of the same species, but even by man. The hunter learns quickly to understand what is called the language of birds and beasts; nor does it require a long apprenticeship to distinguish their sounds of love, passion, pain, or alarm. This kind of language is, no doubt, very rudimentary, consisting, it might be said, of mere interjections, but it is sufficient to establish the mutual relations of these creatures. But does this language differ fundamentally from that of man by the mechanism of its production, its object, and its results? Anatomy, physiology, and experience teach that it does not; here, also, we find a

progress,—an immense development, but nothing absolutely new.

"Finally, as regards the qualities of the heart, which partly depend on instinct and partly on intelligence, we find their manifestations in the animal as we find them in man. The animal loves and hates; it is known how greatly many of them are attached to their young, and how strong is the instinctive hatred with which some animals pursue each other. It is known how the congenital faculties may be further developed by training. We also find among our domestic animals individual characters, as we find among men. We all know how docile and goodnatured some dogs are, and how vicious and irritable others. Man and brute resemble each other, perhaps, most as regards character.

"Where, then, shall we find this something new which is absent in the animal and belongs exclusively to man, and which would justify the establishment of a separate kingdom? In order to overcome this difficulty we shall follow the naturalist, and examine all the characters of the being to which we are to assign a place. We have hitherto directed our attention chiefly to the organic, physiological, and intellectual characters of man; we must now consider him in his moral aspect: here we find two fundamental features which have, as yet, escaped our notice.

"We find in every society, possessing a language sufficiently developed to express abstract ideas, words designating virtue and vice, good and evil. Where language fails in this respect, we find opinions and habits which plainly show that the notions exist, though not expressed in the vocabulary. Even among the most savage peoples and tribes to which, by general consent, is assigned the lowest rank in humanity, we see public or individual actions performed, which show that man recognises something above what is physically good or evil. Among nations farther advanced, the whole political economy rests upon this basis.

"The abstract idea of moral good and evil thus exists in every human society; nothing leads us to suppose that it also exists in animals: here, then, we have the first character of

the human kingdom. In order to avoid the word conscience, which is frequently taken in too restricted a sense, I call morality that quality which furnishes man with the above notions, just as we term sensibility that quality which perceives impressions.

"There are other allied conceptions which are found in all, even the smallest and most degraded, societies of man. Everywhere man believes in another world different from ours, in mysterious beings of a higher nature, which must be feared or worshipped; in a future life after the destruction of the body; in other words, the notions of a deity and a future life prevail as generally as those of good and evil. However faint these ideas may be, they everywhere give rise to important facts. From such notions arise a number of habits and usages which, even among the most savage peoples, are the equivalents of the greater manifestations among civilised peoples.

"Never has anything similar or analogous been observed in animals; we find, therefore, in the existence of these conceptions a second character of the human kingdom, and designate the sum of the qualities which furnish man with these notions, —religiousness."

So far Quatrefages. As will be perceived, he is more in accordance with the facts than his late colleague, Geoffroy; for he acknowledges that the animal possesses all the intellectual faculties,—that it thinks, considers, communicates with its fellows; in short, that the mental qualities are the same as in man, and differ only in degree. But according to him, morality and religiousness are something perfectly distinct and new; and as they occur only in man, they form an essential character, which distinguishes him from the brute. Let us examine these assertions.

We shall assume, for a moment, that what Quatrefages terms religiousness is found among all peoples, without exception; still, this would not prove it to be a new mental quality in man. It would simply prove that man forms ideas concerning certain phenomena which he cannot fathom, which the animal, from its inferior mental capacity, is not induced to take into any consideration. The idiotic crétin takes no

notice of thunder; the simple minded, in ignorance of the cause, fears it; the heathen imagines a thunder-god; the Christian, also, believes that God speaks in thunder; whilst the intelligent man produces himself thunder and lightning when provided with the proper apparatus. This is the usual march of religious ideas; and I know of no sufficient reason for endowing the human race with religiousness as an exclusive quality.

R. Wagner vindicated this religious quality, and even thought that there was an organ of faith in man. The germ, at least, of a belief in some mysterious, higher power exists, also, in animals. The dog is evidently afraid of spectres, quite as much as the Breton or the Basque; every out-of-the-way phenomenon not explained to it by its nose, renders even the most courageous dog a coward. I knew a grove which the peasants firmly believe to be haunted by a fiery spectre, and prove it by the alleged fact that dogs which have passed the night in it will not re-enter it. It is the fear of the apparently supernatural which is the germ of religious ideas; and this fear is developed in a high degree in our domestic animals, the dog and the horse. The germ of these ideas, as well as of others allied with it, being by man developed into a system, becomes a faith. Mathematics has just as much claim, as this belief in the supernatural, to be considered an exclusive, fundamental quality of man. No animal knows mathematics, geometry; but there are animals which can count, though only up to a few ciphers; and this is the germ of the whole edifice which man has erected, and by means of which he has measured the celestial spaces. In the same way, the animal has no faith, but it fears something unknown; and is it not the fear of something unknown—the fear of God—from which man has developed his religion?

With regard to morality, or the idea of good and evil, it cannot be maintained that it exists absolutely in man. It always corresponds to the condition of society; it is, in one word, the result of the social condition. Whilst in the civilised world it is a capital crime for the son to kill his old decrepit father, there are Indian tribes where such an

action is considered praiseworthy. The notions of good and evil arise from the wants of society and the relations of individuals to each other. Now if this be true, it is equally certain that the notion of good and evil is as much prevalent in social animals as in human societies. The first step in society is the family; the notions of good and evil consist, as regards the child, chiefly in obedience towards the parents, and as regards the parents, in caresses or punishment. Observe now in a cat or bear family, the behaviour of the young and their education by the parents, and say, whether it is not the image of a human family in all its manifestations of good and evil. I grant it is cat morality and bear morality which is impressed upon the young, still it is a morality, and the kitten which does not come when the mother calls it, the two-year-old bear who does not properly tend his brothers and sisters, is as much scolded and cuffed as our dear little ones when they neglect the first moral and Christian duty—filial obedience.

With regard to animal societies, I beg to quote an extract from Dr. Brehm's "Illustrirte Thierleben" (illustrations of animal life):—

"The most gifted male member of a horde of apes becomes the leader. This dignity is, however, not conferred upon him by 'universal suffrage'; he only obtains it after having conquered the other male competitors. The longest teeth and the strongest arms decide. Whoever does not voluntarily submit, is bitten and knocked about until he listens to reason. The crown belongs to the strongest, and his wisdom lies in his teeth. The strongest apes are usually the oldest, to which the younger and less experienced must defer. The leader demands and enforces implicit obedience. Chivalrous behaviour is not his affair; he takes the reward of love by storm. No female member of the horde must carry on any love affair. His eyes are sharp, and his discipline severe; he won't take a joke in his amours. The females who should commit themselves, are so cuffed that they take care not to offend again; the youthful ape which intrudes into the harem of his Sultan is treated much worse."

* * * * * * "As for the rest, the leader performs

his functions with great dignity. The esteem which he enjoys imparts a certain independence to his character which is wanting in the rest. He is moreover much flattered, and the females are anxious to grant him the highest favours. They are very zealous to free his hairy garment from troublesome parasites, and he receives this homage with the dignity of a Pacha, whose favourite slave strokes his feet. On the other hand, he watches carefully over the security of his subjects. He surveys every corner; he trusts no one, and so he is always the first to discover any danger."

We do not understand how far the difference between the morality in this simian society, depending on the will of the leader, and that of a horde of Australians, in which the strongest equally lays down the law, is sufficiently important to base upon it a new kingdom. Theoretical absolutism knows no other morality than the will of the ruler. He makes the laws, he establishes the faith, he determines the morality; whoever acts or teaches differently may be punished or killed. Does the morality of an absolute theoretical despotism then greatly differ from that prevailing in a simian society.

Thus this distinguishing category of Quatrefages cannot be sustained. These two French authors have undertaken impossibilities—to find qualities without any material substratum. Where the organisation is formed after the same type, the qualities and functions resulting from it must exhibit the same fundamental unity.

Before quitting this subject, I would, for the benefit of those who wish to erect for man a special throne, quote the following words of Wundt:—"Animals are creatures whose intelligence differs from men only by the degree of development. There exists between man and brute no wider gulf than is to be found within the animal kingdom itself. All animated organisms form a chain of connected beings without an interval. An antiquated psychology, with its great variety of mental faculties, draws here and there lines of demarcation. When we have succeeded in representing mental life as a whole, we are bound to admit that everything animated forms a part of the whole."

LECTURE IX.

Primeval period of Mankind.—Discovery of Human Remains associated with those of Extinct Animals.—Cuvier's Objections.—Human Remains in Caverns.—Formation of Caverns.—Stalactites.—Osseous breccia.—Preservation of Bones.—Mode in which the Caverns were filled.—The Extinct Cavern Inhabitants.—Extinct and Living Species.—Extinction of some species within the Historical Period.—Schmerling's Discoveries.—The Cavern of Engis.—Caverns of Lombrive and Lherme.—Grottoes of Arcy.—Grotto in the Neander Valley.—Grotto of Aurignac.

Gentlemen,—We now turn from the living to the dead. There is, perhaps, no subject of inquiry more interesting than the primeval period of the human species, which reaches further back than written documents or tradition, and to which we can only obtain a clue by the discovery of human remains or objects of human industry. The methods used in historical investigations are inapplicable here, and we are fully justified in asserting that it is no longer the historian and the antiquary, but the geologist alone, who is entitled to give an opinion on the primitive ages, deduced from geological premises. The traces which primitive peoples have left behind, the remains which testify to their existence, are only so far distinguished from those of extinct species of animals, that with their bones and teeth are found associated objects of industry, which sufficiently prove that man, even at the earliest period, applied his mind to multiply the means with which nature had endowed him for the struggle of existence. The hyæna cracks bones by the power of its jaws. Man breaks them with stones to obtain the marrow. The beast defends itself with horns, teeth, and claws, given to it by nature; man endeavours to manufacture arms and tools of bone, horn, and stones, and constant attention directed to these objects leads him on towards civilisation. Animals enjoy the warmth of fire if

they accidentally meet with it; man alone keeps it up, so as to render it serviceable for various purposes. As far as our investigations reach into the recondite past, we find associated with human bones and teeth objects of art, though rudely fashioned, tools of wood, stone, horn, bones, and half-baked clay, together with coals, which prove that man knew the use of fire. But there are no traditions, no legends which can serve as guides in reference to the first period of human existence. Even in the oldest civilised countries, where from the earliest period monuments and statues speak in hieroglyphics, whence great scholars have endeavoured to collect the old traditions and to decipher the primitive history of the country—even in these oldest traditions there is no trace of a pre-historic non-metallic period of which stone hatchets and pile-structures testify. It is only the position of these relics, their relation to the beds upon which they rest, or by which they are covered, their association with other vegetable and animal remains, which can afford any clue to the relation of the primitive man to the external world, his mode of life, alimentation, dress, habitation, customs, manners, and social condition.

The field, as you will observe, is very extensive; the way to it is dark; knowledge difficult. From the fragments of the scenery after the theatre is burned down, we are to guess the pieces which have been played; from the remains of those who have perished we are to say what part they played. Wherever we cast our glance, there is uncertainty and doubt; it is only with the greatest caution that we can grasp a guiding thread which in this labyrinth may lead us to a starting point. The least mistake in observation may engender an innumerable series of errors; every unfounded or illogical deduction may lead us so much astray that return becomes impossible. But the most dangerous rocks, against which the vessel of the inquirer must inevitably be wrecked, are the traditional prejudices of church dogmas and biblical exegesis. Whosoever here attempts any mediation is at once carried into a whirlpool of absurdities, from which no degree of prowess as an oarsman is able to extricate him. But the greater the difficulties, the greater the satisfaction of the inquirer who may succeed in raising a

structure upon the foundation of facts—a structure which may brave both the attacks of criticism and the serpent tooth of hatred. In proportion as error is easy, so is our admiration sincere for such men as devote their industry and their minds to throw light into the Egyptian darkness.

It is my object to lead you at once into the remotest antiquity known to us, and I shall treat in this lecture of fossil man. Not of fanciful stone-forms, or skeletons of unknown animals; not of that petrified horseman, designed upon a block of sandstone at Fontainebleau, and about which they quarrelled in Paris forty years ago; not of the salamander of Oeningen, which Scheuchzer took to be the remains of a four years old child, and under a portrait of which a theologian wrote the touching lines—"Melancholy skeleton of a poor sinner, soften the stony heart of the present generation!" I shall say nothing of such mistakes, but shall treat of real and undoubted human remains, found associated with extinct species of animals, and petrified animal bones, in strata whose great age is undoubted.

I have here indicated the limitation which the expression "petrified" or "fossil" must undergo, if it is to be correctly applied. The question is not whether human bones are more or less penetrated by solutions of petrifying salts, or more or less deficient in organic matter; the question, on the contrary, is whether the primitive man saw animals different from such as now exist in our country; whether he hunted other beasts than such as inhabit our forests; whether he dwelt upon a surface which has changed since the historical period; whether he survived convulsions, which destroyed a number of animals.

Until a recent period, this question was unconditionally answered in the negative. Cuvier laid it down, that the occurrence of human remains along with bones of extinct animals was unproved; that the facts adduced rested upon error; that the petrified Guadaloupe skeletons were recent formations; and that fossil human bones would not be found associated with those of extinct animals. As is usually the case when some great authority lays down a law, so it was here. The facts discovered, here and there, were neglected,

considered as errors, and everthing relating to fossil man was set aside. When, however, latterly, there were found products of art, stone hatchets in beds containing bones of extinct animals, the attention was again directed to the results formerly obtained in the exploration of grottoes and fissures. The methodical examination of such spots was now carried on with renewed zeal, and though but a comparatively short period has elapsed since these studies were recommenced, the results obtained are great. But before touching upon the discovery of human remains in caverns, grottoes, and fissures, I must offer some few observations on certain geological phenomena and important facts pertaining to this inquiry.

It has been repeatedly and justly observed that, there is scarcely any solid rock upon the earth which is not somehow torn or split; it has even, with some exaggeration perhaps, been maintained, that there is not a block found of the size of one cubic meter which does not show some fissure. These fissures are generally very fine, and frequently newly cemented by trickling water. Thus, in dark-coloured chalks, we frequently find a network of white calcareous veins representing the original fissures. The lodes which are sterile or filled with ore, are but large fissures of this kind, which have gradually been filled with the deposit of mineral matter. In these deposits, again, are found cavities not filled up. Fissures quite empty are also frequently seen. In other instances, it may be seen how the trickling water not only furnished crystalline deposits, but that clay, earth, sandstone, and pebbles have been introduced into the fissures. Nothing is more frequent than to find such deposits in the fissures, so that the margins of the crevices do not exactly correspond, and, if the fissure be not perpendicular, there are alternate contractions and expansions. Neither is it rare to find fragments of the surrounding rocks filling the fissures; and there are even mountains and hills presenting the aspect of heaps of irregular superposed blocks with intermediate fissures, whose form and size is constantly changing under the influence of atmospheric action.

Whilst, on the one hand, the trickling waters form in most stones crystalline deposits, it is undoubted that they also

extract from the rocks certain elements, and that this extraction is nowhere greater than in the gypseous and chalk mountains; because in these latter the dissolving power of simple water is augmented by the addition of carbonic acid, which is found in all atmospheric waters. For this reason, a deposit will be specially formed in such fissures, where a small quantity of water trickles down slowly and partly evaporates, whilst, on the contrary, where large quantities of water pass through rapidly, the fissure becomes rather enlarged by the removal of its contents. The origin of the large cavities in horizontal fissures is, however, mainly attributable to the falling in of beds deprived of their supports, which thus form wide spaces in the interior of the mountains.

All these phenomena, from the finest crack to the largest cavern, are closely connected; their formation being confined neither to time nor place; the filling up depending on local conditions. Where there is no access for the water from above, it can only enter from the sides or springs which may rise up from beneath. If there be external apertures, springs, brooks, and streams may enter and form a subterraneous river system, as actually existing in many spots, but nowhere so well developed as in Carinthia and the Krain on the platform above Trieste, where is found a series of subterranean lakes connected by rivers, partly navigable, and inhabited by various animals.

It is customary to make a distinction between crevices of little width, running more or less perpendicularly; grottoes, which are but short cavities, with externally wide apertures; and caverns, consisting of a succession of vaults, connected by narrow channels. The grottoes, or balmen as they are called, (probably from a Celtic word) in Switzerland, South Germany, and France, frequently owe their origin to soft beds of marl, carried off from beneath the harder lime beds, which now cover them; they are often only the inlet of caverns cut off by the closure of the fissure. Caverns, on the contrary, are sometimes of surprising dimensions, extending in some cases for miles under the ground, frequently containing chambers one hundred feet in height, and as many in diameter. These chambers are not always situated in the same plane, but have to be reached

from above or from below by ladders, and the entrance is sometimes so narrow that it requires to be enlarged before a person can pass through.

Having thus shortly described the formation of the crevices, grottoes, and caverns, let us glance at their internal condition. Most of these caverns are found in the chalk formation of old and recent origin. The Devonian and carboniferous limestone of Ireland, England, Belgium, and Westphalia; the magnesian limestone of the Hartz mountains; the Jura limestone of France, Germany, and Switzerland; the chalk and the nummulitic masses of the Pyrenees, Alps, and Apennines contain caverns, some of which have acquired sufficient celebrity to attract numbers of travelling sight-seers. What first strikes such tourists is the curious form of the stalactites, which by torchlight assume most fantastic shapes. These stalactites are but the crystalline deposits of the trickling water which hold lime in solution, and they appear brown or yellowish according as the water is impregnated with clay or earth. The size of these stalactites gives no certain clue to their age. The deposits vary even in the same cave according to the quantity and quality of the water. Bones and pebbles are rarely found in the stalactites. This only occurs when the cavern is entirely covered with deposits; when the stalactite mass forms only a crust in the roof and the walls, but does not hang down in the form of icicles.

The lime water trickling down from the roof or the walls, forms a crust on the floor of the cave, which, in contra-distinction to that on the roof, is called the stalagmite crust. Corresponding to the spots where a larger quantity of water has trickled down, there are eminences and columns which frequently unite with those which hang down from above.

There are grottoes without stalactites. Such caves as contain but few stalactites are best adapted for further researches.

Beneath the stalagmite crust are usually found deposits of a so called osseous earth. This is usually a yellowish fatty earth, a clay mixed frequently with sand, often exhibiting a kind of stratified form. In or beneath this clay pebbles are

found, which must have come from a distance, as they belong to different formations from those found in the vicinity of the cavern. The clay is either loose, or so penetrated with lime that it forms a solid cement, which can only be split with a chisel. At times there are found angular stones, mostly detached fragments from the walls of the cavern. The deposit of this ossiferous clay is frequently very thin, but in some cases so abundant, that it is stated that in the grotto of Banwell in England, one chamber fifteen meters high is nearly filled with this ossiferous mud.

We are, in fact, perfectly justified in designating this cave clay, mostly of a reddish tinge, which is only reached by piercing through the hard stalactite deposit, as osseous clay; for in it we find frequently a considerable quantity of bones. Besides these bones, to which we shall presently advert, we meet in the clay land and freshwater snails, which belong to species still existing in the same spot.

The bones lie in this clay pell-mell, without any trace of order. The skulls are usually separated from the lower jaws, the other bones of the skeleton lie scattered about. Skeletons complete in the relative positions of the parts have probably never been found; even such a discovery as that made in the cave of Brixham, where all the bones of the posterior leg of a bear were found in their proper position, is a rare exception. It seems, however, that in most cases the bones had been introduced into the caves more or less with the flesh attached, as most of them have preserved their sharp angles and margins; others, however, have manifestly been transported and rounded, whilst others, again, are split up, just as if they had, previous to their introduction, been long exposed to the action of the atmosphere. In many caverns, bones have been found evidently gnawed or cracked, while some presented manifest traces of having been worked by man.

The preservation of bones gives no clue to their age. Where the stalactite roof is wanting, and the mud remained dry, the bones are so decayed that they crumble into dust on being touched. Where there is a stalagmite floor, they are in a better state of preservation, and have even conserved the

organic matter they contained at first. In most cases, however, the bones have lost the greater portion of it, and adhere to the tongue—a quality which formerly, but erroneously, was considered as the characteristic mark of a fossil. In the fissures filled with bones which are found in the Mediterranean region, the red clay, as well as the bones, is frequently so impregnated with lime as to form a true breccia, which must be blasted with gunpowder, and whence the bones are only hewn out with considerable force.

The clue to the period in which the deposits in the fissures and caves took place, must be furnished by the bones and other remains. Animals of the same species lived in the same geological epochs, which no doubt lasted for an incalculable series of years; animals of the same species belong, therefore, to the same geological chronology. It can, however, be easily shewn, that similar conditions may prevail in different geological epochs, and produce the same effects. When the small tunnel between Morges and Iverdun was commenced, there were found in the yellow limestone, which belongs to the lower chalk system, crevices filled up with brown-red osseous clay, the traces of which are still visible at the southern entrance of the tunnel. The bones contained therein belonged to pachydermata of the tertiary period, and were mostly identical with the species found in the gypsum of Montmartre near Paris. These bones were consequently much older than those usually found in ossiferous caves. On the other hand, in 1860, on the Stoss in the Muotta valley in Canton Schwytz, near a place called "Bärentross," 5,042 feet above the level of the sea, a cave was discovered in which a whole bear family, consisting of six animals old and young, lay buried in a bed of clay two feet thick covered with a crust of lime tufa half an inch in thickness. "The bones themselves," says Rütimeyer, "are also covered with a thin tufa crust, and are in excellent preservation. Some are in possession of the College of Schwytz, others in that of Landamman *Auf der Mauer* in Brunnen. The largest skeleton lay in an outstretched position, the two anterior extremities seemingly broken off by a fragment of rock which fell from the roof. The largest skull which I saw in Brunnen measured 285 milli-

meters from the *foramen magnum* to the incisive alveoli, and 200 millimeters in width at the level of the zygomatic arches, and thus must have belonged to a very large animal. A larger skull is said to be in the College of Schwytz. The well-preserved teeth rendered it easy to ascertain that the skull belonged to a brown bear. Significant is the circumstance, that the locality where this bear cave is situate is called upon the maps 'Bärentross,' from 'Troos,' *alnus viridis*, which tree is abundant there, a circumstance which indicates a recent habitation of the cave." Here, therefore, is an osseous deposit of a comparatively recent date, at any rate much more so than the deposits usually found in caves.

Before proceeding to the age of these deposits, I must be permitted to say a few words on the mode in which these caves were filled up. The bones are generally those of beasts of prey. In Europe, to which portion of the globe these remarks apply, it is chiefly the bones of bears and of hyænas which have been found. These two animals inhabit caves, and as is proved by the cave in the Stoss, they may have been overwhelmed by the falling in of blocks of stone, and thus buried in the clay. This could, however, have happened to but few individuals, though several successive generations of such animals may have inhabited the same cave; but the circumstance that thousands of individuals are found buried together in such caves, shows that other causes must have been at work. There are proofs that some caves were inhabited by carnivora, who introduced bones to feed their young, which was especially done by the hyænas, whose coprolites contain undigested bones. The bears, though they also inhabit caves, to which they retire chiefly for hybernation, did not introduce bones. Again, large collections of bones are found in cavities which can only be reached by ladders, to which no living animals could have had access. Hence but few caves are entirely filled up with the bones of its former inhabitants, some remains must therefore have been introduced by some other causes.

Sick and dying animals usually retire to caves and fissures, to die or to recover. Many bones have been found showing that the animals had been wounded or that the bones were

carious or otherwise diseased. Schmerling has described a series of such diseased bones found in the Belgian caves. Soemmering described a hyena skull the parietal portion of which had been bitten, and afterwards partially healed. Such animals may also have furnished their contingent of cave bones.

But if these three causes were thoroughly established, we ought, as in the cave at the Stoss, to find entire skeletons of the carnivora. But so little is this the case, that caves which have been completely explored furnished bones of several individuals, but rarely all the bones belonging to the same skeleton. We shall recur to this fact when speaking of human bones.

There remains, then, as regards most caves, only the assumption that the bones, together with pebbles, shells, and other relics, have been carried into the caves by water. If the bones show traces of having been rolled, or bleached, or dried, they may have been introduced in that condition. Where they are better preserved, they were probably floated pieces of putrefying carcasses. As the mouths of caves and grottoes are frequently several hundred feet above the valleys, we are justified in assuming that in certain localities the watermark was much higher than it is now, and that the brooks carried a larger quantity of water. In many caves the deposition must have been effected very gradually, as shewn by the stratification of the mud intermixed with layers of sand and pebbles. In other caves the deposition was more irregular, and probably effected under the influence of cross streams. The small size of the pebbles shows, however, that the current could not have been very violent. Violent currents may have occurred, but only in few localities. That caves containing no pebbles have been but very gradually filled with mud by the introduction of the melting snow waters is proved by the cave at the Stoss, which is situated at a height and in a locality where the idea of a brook cannot be entertained, and which nevertheless has within a comparatively short time been filled with a layer of mud two feet in thickness.

On examining the remains of such species as have hitherto been found in caves and the so-called diluvium, we first obtain the fact, that a great number of species, and particularly such

as furnish the greater number of bones, are those of extinct animals. To these belongs the powerful cave bear *(Ursus spelæus)*, whose skull is distinguished from the present species by its great size, the constant absence of the small gap-teeth, the curved forehead and the prominent frontal eminences, forming a ridge upon the forehead. Though Blainville considers all the remains of bears found in caves as of the same species and identical both with the brown bear of Europe, and the grey and the black bear of North America and Europe, all other naturalists have given as the results of their labours that the difference between the cave bear and the present living species is greater than that obtaining between existing different species, so that we must either assume that all living bears belong to the same species, or that the cave bear represents an extinct species. Along with the remains of the cave bear there are found, though rarely, skulls which seem to form a transition to the brown bear.

The cave hyena (*Hyæna spelæa*), also, is an extinct species. It was larger and more powerful than the spotted hyæna of the Cape, the remains of which have recently been found in Sicilian caves. In caves of southern France were also found the remains of a hyæna resembling the striped species. The cave lion (*Felis spelæa*), which in size and strength excelled the present species of lions and tigers, is also extinct. It is found up to the Harz, whilst an extinct species of large cats (*Felis antiqua*) resembling the panther or leopard, has hitherto been only found in the Franconian Jura and south of it.

To the extinct rodents belongs a beaver, (*Trogontherium Cuvieri*) the skull of which is larger by one-fifth than that of the present species; a hare (*Lepus diluvianus*) which is found in the region of the Mediterranean, and seems to occupy an intermediate place between the hare proper and the piping or calling hare, (*Lagomys*) at present confined to northern Asia, some species of which formerly existed in central Europe, but are now extinct; a squirrel-like rodent, (*Sciurus priscus*) which is essentially distinguished from other species of squirrels, and a digging mouse, (*Arvicola brecciensis*) almost the only contents of osseous fissures in Sardinia; even among the insec-

tivora, which excepting in the formation of the teeth, are nearly allied to the rodentia, a species of shrew (*Sorex similis*), formerly native in Sardinia, now perfectly extinct, has been found.

Among the ruminants the deer species were well represented, and belong to the extinct animals. The splendid Irish peat deer (*Cervus euryceros*), which in size equalled the reindeer, and possessed enormous antlers, whose size and weight seemed out of proportion to that of the animal; the gigantic deer (*Cervus somonensis*) which occurs in northern France, and some less-known species found in French caves, are all extinct. So too are certain antelopes (*Antelope Christoli* and *dichotoma*) found in caves of the south of France, a wild goat (*Ibex Cevennarum*) of the Cevennes, and other two species of oxen (*Bos primigenius*), of which we shall speak when treating of domestic animals.

Of all extinct species the pachydermata have excited the greatest attention. No horses, of which an extinct species (*Equus fossilis*) has, however, been discovered in France; but of the hippopotamus, rhinoceros, and elephants, some perfectly preserved carcasses, especially of the latter, have been found as far north as the coast of the Arctic sea. There existed probably several species of extinct river horses (*Hippopotamus Pentlandi, major, minor*) extending to England and Russia, which could as easily have supported themselves in the marshy lakes and large rivers of the diluvial period, as they can now in central Africa. In Europe we find two* different species of elephants; the one of which (*Elephas meridionalis*) was essentially confined to the Mediterranean region, where it occurs along with a rhinoceros (*Rhinoceros leptorhinus*), which resembles the double-horned rhinoceros of the Cape; whilst the other species, the mammoth (*Elephas primigenius*), and another species of rhinoceros (*Rhinoceros tichorhinus*), carrying two horns upon a nose, supported by an osseous septum, was enabled by a warm hairy coat, which is wanting in the present species, to

* Sir Charles Lyell, in his recent address to the British Association at Bath, makes the following observations on this point: "We have now, therefore, evidence of man having coexisted in Europe with three species of elephants, two of them extinct (namely, the Mammoth and the *Elephas antiquus*), and a third, the same as that which still survives in Africa."—Editor.

support existence in the northern regions. It seems remarkable that an elephantine species, the mastodon, which in the alluvial formations of North America replaces the elephant, is also represented in Europe by a species (*Mastodon angustidens*) which appears in the old layers of the tertiary period.

We shall presently have to examine whether these various species, which, excepting the mastodon, resemble the present living species, have become extinct at the same period.

All other species hitherto found in caves and the alluvium, agree with the existing, excepting in size, which seems to increase in the older bones. It has, however, been justly observed, that this character is insufficient for the distinction of species, as it frequently depends on the abundance of food, and facility of procuring it. One of the bear skulls found at the Stoss, far exceeds in dimensions any of the brown bear recently found; yet, in the bear menagerie of Berne, they have, according to Rütimeyer, brought up bears which attained an equally colossal size. Pictet seems, therefore, perfectly justified in declining to assume difference of species from the mere size of the fossil bones. On examining the list of bones hitherto found, we observe that almost all mammals of the present fauna of Europe, excepting some few and not easily to be distinguished species, or manifestly imported domestic animals, were represented in the diluvial period, so that the fauna of Europe was richer then than it is now. Pictet enumerates all these species, and shows that but a few small species are wanting, and that, even recently, species, such as the porcupine and the moufflon, the ancestor of our domestic sheep, have been discovered in Italy. There can, therefore, be no doubt, that most living species existed in the diluvial period; though it is going too far to deduce from this that no new creation or origin of species had occurred within or since the diluvial period. In the same way as the extinct species disappeared at different periods, so may the present existing species have arisen at different times, though within the same great epoch.

As regards living species, the remains of which are also found in the caves and alluvial mountains of central Europe, there is, again, found a difference, in so far as many of these species have changed their habitat, and have entirely withdrawn

from the region they previously occupied. This phenomenon is not peculiarly striking, as it is repeated within historical times. The deer, the beaver, the ibex, formerly plentiful in Switzerland, have now entirely disappeared. The wolf is exterminated in England; the bear is so in the greater part of Germany. On casting a glance at this departure of species, it seems singular, that most of such as formerly inhabited central Europe have retreated northward; that consequently at the diluvial period there existed in the heart of Europe a fauna, the remains of which are at present only found in the north. These northern, but formerly central-European animals, include the glutton, the icebear, hamster marmot, the lemming, the reindeer, the elk, the aurochs, the musk ox, the walrus. Some of these species are apparently becoming extinct, as the bison (*Bison Europæus*), of which there exists only a single herd in a Polish forest. Others hover, as it were, on the boundary of the German continent, as, for instance, the elk, which inhabits only a small portion of the coast of the Baltic, but is found in Scandinavia, and Russia: others have retreated to the Arctic circle, as the lemming, glutton, and reindeer; others, again, now inhabit the icy mountain regions, as the chamois, marmots, and ibex. Whilst among the extinct species types are found, which are at present confined to regions south of the Mediterranean, as lions, hyænas, and riverhorses; we find among the departed species scarcely a well-founded instance of a retreat to the south; and as regards the extinct species, as the elephant and the rhinoceros, we may conclude that they retired to the north, step by step, until they found the limits of their existence in Northern Siberia. This view is supported by the fact that the "collared lemming" (*Lemmus torquatus*), at present existing in the highest north beyond the forest region, is now only found in the ossiferous fissures of Northern Germany, but never further south.

Since, then, of the extinct species, the cognates of which at present inhabit southern climates, some had by their woolly skin been enabled to support the cold, it gives rise to the presumption, that other species, with whose bones only we are acquainted, but of whose integuments nothing is known, may have been similarly protected from the cold. As it is

further known, that the tiger of south Asia makes excursions to Siberia, up to the 50 deg. north latitude, and even in regions, as in the Amoor, where the mean temperature in the winter is — 20 deg. R.; and as we may suppose that the cave tiger was equally enabled to support the cold; and as even the hyænas, which inhabit northern Africa, are found on the highest ridges of the Atlas mountains, covered in winter with ice and snow, we are fully justified in concluding, that from the beginning of the diluvial period there reigned in central Europe a much lower temperature than at present, and that the animals, with the increase of heat, at least partially retired northward, following the temperature to which they had been accustomed in central Europe. A considerable portion of central Europe may, at the beginning of the diluvial period, have presented the same aspect as the damp and marshy plains of Poland, Lithuania, and Siberia do now.

We have to some extent wandered from our subject. In endeavouring to give you a sketch of the society in which the primitive man lived, and showing the conditions in which human remains are found in caves and fissures, I have involuntarily digressed to describe the climate of the period which these remains indicate. Let us then return to our starting point, and examine the caves and fissures in relation to the remains they contain.

History shows that caverns were at all times either places of refuge, or habitations for more or less civilised peoples. The ancients speak of troglodytes, or cave dwellers, in Asia Minor, Greece, and Italy. Christian and heathen assemblies, when subject to persecutions on account of their religion, were held in forests and caverns. Cæsar gave orders to his lieutenant Crassus that the Gauls should be shut up in the caverns of Aquitania and destroyed, just as the famous warrior Pelissier smoked out the Arabs who objected to having French civilisation forced on them.

Certain caves and fissures served as places for execution, the criminals being thrown down and abandoned to a miserable fate; other caves were used as burial places. Most caves and grottoes serve even now as places of refuge for shepherds in tempestuous weather, or even as temporary dormitories. It is

thus not surprising that in many grottoes and caverns are found human bones or objects of art and industry from remote periods to the present time. Thus in the cave of Mialet near Anduze in the Cevennes were found fragments of pottery, Roman lamps, the statuette of a senator in his toga, in yellow burnt clay, also Roman antiquities with polished stone hatchets and other stone weapons which belonged to an earlier period. In one part of the grotto was a grave filled with human bones dug in a sandy clay containing bones of the bear. In other spots of alluvial soil were found objects of art manifestly more recent than the ossiferous clay which it covered. In the background of the grotto were seven or eight bear skulls so surrounded by stone blocks, which had become detached from the roof, as to resemble a monumental group. There is no doubt that all these objects must belong to a later period, as it is historically proved that at the time of the dragoonades of Louis XIV, the persecuted Protestants worshipped in this cave. I merely cite this example to show that such late deposits occur partly above and partly between, and in the osseous clay itself, in the absence of a stalactite roof, or if it has been subject to the exploration of intruders. But all these recent intermixtures in the caves may be easily detected on careful examination.

The finding of human bones in the same condition as the animal bones is different when they are met with imbedded in clay showing no sign of having been disturbed, and when they are intermixed with the bones of extinct animals covered by a stalactite roof imbedded in stalagmite, so that bear- and human bones are cemented in one mass. In such cases, and especially if the discovery is made by careful and trustworthy observers, there can be no doubt that man who was buried with the bear also lived with him. To establish this fact, I shall cite a few instances which inspire us with confidence from the character of the observers, and which will assist us in our investigations, as regards the origin of mankind and the different races.

Dr. Schmerling of Liège published in 1833 a classical work on the caves of his own country. Each of these caves, some of which have now disappeared by being quarried out, was

minutely explored by him and some of them emptied of their contents, and each bone separately examined. Schmerling observes on the condition of the fossil human bones in his possession :—"They, like the thousands of bones which I have collected within a short time, are characterised by the degree of their decomposition, which is quite the same as that of the extinct animals. All, with few exceptions, are broken; some are rounded, as is frequently observed in other bones. The fractures are transverse or oblique; nowhere a trace of being gnawed; the colour, varying from yellow to black, does not differ from that of other bones. These are all lighter than fresh bones, excepting such as are covered with a layer of chalk tuff or have their cavities filled with such a deposit."

The most important object in Schmerling's collection is the upper part of a skull from the eyebrows to the occipital foramen, which was found in the cavern of Engis at the depth of 1½ meter, in an osseous breccia one meter in width, 1½ meter in height, attached to the wall of the cave. The earth which covered this skull showed no trace of having been disturbed; it contained the remains of small animals, teeth of the rhinoceros, horse, of hyænas, bears, and ruminants, which surrounded the skull on all sides. In order to reach the cave, Schmerling and his companions had to descend by means of a rope attached to a nearly perpendicular rocky wall. In a sort of antechamber five meters in width, six meters high, and seventeen meters deep, was seen near the opening of the cave a layer of osseous earth two meters in thickness. In this were found, besides the usual animal bones, an incisor, a vertebra, and a finger bone, all human, together with several stone hatchets of triangular shape. A little beneath this cave was a second aperture leading to another chamber, twelve meters deep, five meters high, and four meters wide; this again led into a semicircular gallery which contained many bones, and terminated in a narrow fissure preventing any further advance. There is on the other side a rising gallery leading into a small hall, which seems filled with osseous earth. Here it was that the skull, which we shall henceforth call the Engis skull, was discovered. Besides this, was found the skull of a younger

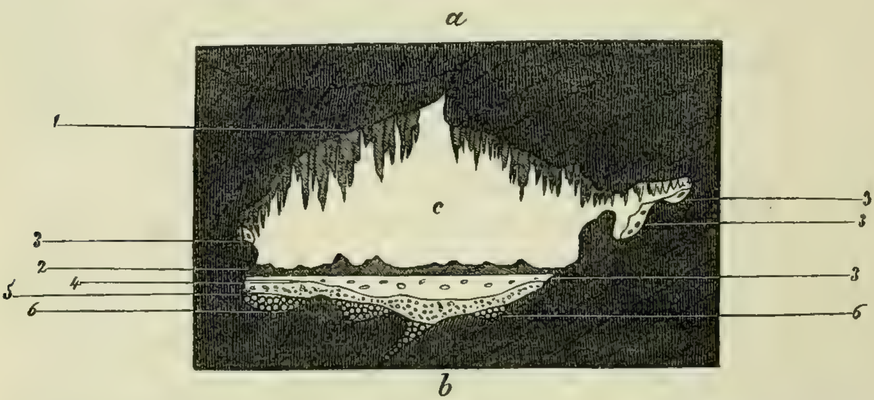
individual at the bottom of the cave, and also an elephant's tooth. This skull was entire, but when Schmerling tried to lift it up it fell into dust excepting some pieces of the jaws. The other human bones found by Schmerling, clavicle, radius, and carpus, as well as bones of the foot, did not excite so much interest, but they showed that they belonged to three different individuals. Schmerling had the whole cave emptied, but he did not succeed in finding the component parts of the whole skeleton. In front of the aperture of the cave was osseous earth, covered with a luxuriant vegetation. It was thus certain that only separate putrid portions of human bodies had been carried into the cave by the waters along with the bones of bears. The difficulty of access and the absence of certain bones render the assumption that several human bodies had been buried in the cave impossible.

In another cave, that of Engihoul, there were also found, and under the same conditions, the remains of at least three individuals. Here were only found some insignificant cranial fragments, though a large quantity of the bones of the extremities. There was also found a piece of the radius and of the elbow cemented together by stalactite, and Schmerling calls attention to the fact that all conditions, including the peculiar distribution of the bones, were quite the same as with the bones of other animals.

In Southern France there runs along the Pyrenees a chain of low chalk mountains, which are remarkably torn up and fissured. Two caves found in this range, namely the caves of Lombrive and Lherm, Department of Ariège, have recently acquired importance by the discovery of entire skulls and remarkable implements. I give you the details, because a pamphlet published at Toulouse by Messrs. Rames, Garrigou, and Filhol does not seem to have excited any attention, and also because I was fortunate enough to examine two skulls which Dr. Garrigou brought to Geneva. It is the more surprising that Lyell should have taken no notice of this discovery, as we know that he has at least heard of it, and as this discovery is in every respect more important than many others made in England which excited so much attention.

The cave of Lombrive, say the authors, is about 4,000 meters in length. It consists of a series of wide halls, which are connected by long and narrow passages. Here and there are side galleries. In some parts the roof is so low that we must creep through. The entrance has been widened by a small tunnel. Tourists have for a long time visited the cave on account of the stalactite formations. The ground and the walls

Fig. 84. Section of the Cave of Lombrive.



a, *b*. Section of, passing through the Cave. *c*. Interior of the Cave. 1. Stalactites. 2. Stalagmite crust of the floor. 3. Ossiferous clay. 4. Plastic clay. 5. Gravel, with small pebbles. 6. Large rolled stones.

exhibit traces of having been scooped by water, presenting stripes, furrows, and deposits of gravel, sand, mud, and bluish clay. The deposits are also found in the small side grottoes, which frequently lie above the level of the chief cave. They contain bones, and are here and there covered by stalagmite, the surface of which resembles the surface of the sea ruffled by a light breeze.

The cave has two entrances, at a little distance from each other, through which the waters escaped, in a direction indicated by a gradual elevation of the floor of the cave backward, but especially by a perpendicular precipice, which abruptly divides the cave into two portions. Five fire-escape ladders are requisite to ascend this precipice. Above it there is a long narrow passage, from which but little water escaped, so that the posterior and wider portions of the cave formed at one time a large pond, in which the most interesting deposits were

formed. The floor of the cave still shows a small pond, on the right side of which was formerly an opening. There the deposits of pebbles and mud rose to the roof, forming a large cone, which obstructed the fissure through which the waters entered.

The cave lies far above the influence of the present state of the waters, on the declivity of a steep mountain, in which, among others, open also the remarkable caves of Sabard and Niaux, which are on the same level, show the same deposits, and were probably connected at an earlier period. In the valley of Vicdessos, above the village Niaux, are seen well-characterised diluvial formations, composed of the same elements as those in the caves.

The deposits in the cave consist of regular layers of rolled stones, sand, clay, and mud, which are very distinctly seen in the background of the caverns where the stalactite roof is wanting.

Large rolled stones, sometimes a meter in diameter and rather disconnected, form the lowest stratum (6, fig. 84), sometimes resting immediately upon the jura lime, sometimes upon the stalagmite. Where this layer is exposed, it resembles the bed of a forest brook, upon which walking is rendered difficult (5, fig. 84).

These two layers of rolled stones contain all specimens of the rocks of the Pyrenees; they are identical with the rolled stones of the diluvium of the adjoining valleys, where are also found rolled fragments of stalactite.

Above these rolled stones lies a stratum of grey plastic clay, (4,) which is preserved in but few spots, having been washed off in the rest.

A fine ferruginous and calcareous sand, a real loam (3), forms the uppermost layer of the diluvial deposit; it fills up the parietal grooves, and even the grottoes, to a height of ten meters above the level of the cave. In some spots, where there was a rotary motion, it forms considerable elevations. In this loam, and sometimes in its stalagmite incrustation, lie human bones intermixed with those of carnivorous and herbivorous animals, namely, of the brown bear, urus, reindeer, stag, horse, and some undetermined species of a small kind of

ox, and a species of dog differing from the fox and jackal. The bones are chiefly found in close intermixture in the middle of the cave, in a large gallery, where there, no doubt, existed a small lake. All these bones present the same physical and chemical characters, being light, sonorous, and friable, adhering to the tongue, of the same colour, and containing the same amount of nitrogen. Many bones are broken in pieces and rolled, especially in the case of the skulls, some still covered with flesh, which, by its decomposition, imparted a disgusting odour to the osseous breccia. In a calcareous breccia, formed of broken and rolled bones of several hundred individuals, there was a whole skull, and near it some broken, not rolled, fragments of bone, belonging, probably, to the same individual. A second smaller skull has since been found. Among objects of art may be mentioned some perforated canine teeth, which were probably worn as amulets or trophies.

These skulls, which we shall describe presently, and which at any rate are almost the best preserved we possess, belong to a period in which the reindeer, the urus, and the old bear, resembling the brown bear, lived in the Pyrenees, but when the cave-bear and the cave-hyæna had already diaappeared. These skulls are therefore not so old as those found in the Belgian caverns.

In the same Department is the cave of Lherm, of but little depth, but with narrow or wide passages in every direction. The walls are bare, but here and there covered with large protuberances. Nowhere are furrows or channels indicative of the passage of water to be seen. The bottom is almost everywhere covered with a thick layer of red mud, containing no rolled stones, but is in many places covered with a hard crystalline stalagmite. The entrance to the cave, obstructed by large blocks, leads into a gallery, the stalactites of which can be easily detached, whilst the mud is only present in small heaps. The gallery divides into two passages, the right leading down a terrace into a wide hall, to which some side grottoes impart an irregular form. From the roof hang down some stalactites; the thick red mud is covered with stalagmite; there is mud in the side grottoes of the same kind, but without

stalagmite. The passage to the left is narrow and winding, leading almost horizontally to an abrupt precipice, beneath which a large hall opens, the roof being formed by loose blocks which threaten to fall at any moment. The floor of this cave is very declivitous. On the elevated spots are large heaps of ossiferous mud, and in the depression there is a bed of osseous mud incrusted with thick, smooth, and uniform stalagmite. In the most precipitous spots there is a threefold alternation of mud and stalagmite.

In this ossiferous mud were found, along with teeth, shoulderblade, arm and foot bones of man, a number of bones of the cave bear, the old brown bear, some few remains of the cave hyæna, cave lion, dog, wolf, and some species of deer. Of the cave bear there were seven skulls, fifty half lower jaws, above 300 teeth and all the bones of the skeleton, and some bones of embryos. The human teeth were found in a thin mud layer intermixed with hyena and bear teeth, under a thick stalagmite covering which was so crystalline that when struck with the hammer it split into large crystalline planes. This crust had never been disturbed. Besides the human remains were found evidences of human industry: a triangular flint knife, a round bone of the cave bear which had been transformed into a cutting instrument, three lower jaws of the cave bear, the ascending rami of which were perforated for the purpose of hanging them up, and the trochings of a deer carved and pointed. The most remarkable weapons however consisted of twenty half jaws of the cave bear, from which the ascending ramus had been struck off and the body of the lower jaw had been so carved that it presented a convenient handle. The projecting canine tooth thus formed a hook which might serve as a weapon, or a hoe for digging up the earth. Had we found, say the authors, but one sample of these singular tools it might have been objected that it was merely accidental, but having found twenty, all worked in the same manner, how can we speak of accident? We are moreover enabled to follow the method by which the primitive man gave this form to the jaw. In each of the twenty jaws may be seen the traces of incisions made with the edge of a badly sharpened flint

knife. From the absence of rolled stones and the condition of the mud, which contains many excrements of hyenas, as well as traces of coals and fire, the authors conclude that beasts and human beings inhabited the cave of Lherm alternately, but that at all events man lived simultaneously with the extinct cave beasts, since he worked their bones into weapons and tools. No valid objection can be made to this deduction.

A convincing proof of man having been the contemporary of the cave bear has been furnished by the exploration of the grottoes of Arcy near Avallon in the Department of the Yonne. M. de Vibraye, who explored these grottoes, the largest of which attains, including its halls, a length of 876 meters, whilst the second or the fairy grotto in which most bones are found reaches only 150 meters in length, distinguishes in these caves three kinds of deposits. The lowest deposit, intermixed with rolled stones from the granite of the Morvan, lies immediately upon the jurassic lime, in which the cave is imbedded, it fills up depressions and thus forms a stratum of variable thickness.

There are found in it the cave bear, the cave hyæna, the rhinoceros with a bony septum, the mammoth, the river-horse, the urus and the horse. In this lower stratum, which has a mean thickness of about one meter fifty centimeters, was found, among a large accumulation of bones chiefly belonging to cave bears, a human lower jaw, and subsequently a human tooth. The jaw, externally, resembles exactly the bones of the cave bear, which, however, have mostly a thin carbonaceous crust, the result, probably, of the decomposition of the skin and the soft parts still attached to them. The middle layer of about seventy-five centimeters in thickness consists almost entirely of calcareous fragments from the mountain. The red cement which connects the lower stratum of rolled stones, forms here, only an incrustation of the fragments. In this second middle layer, bear and hyæna bones are no longer met with, but numerous bones of ruminants, including those of the reindeer. Quite on the top is a very irregularly disposed stratum of marly clay, of white-yellow colour, fatty and soapy to the touch.

Though the jaw, found under such circumstances, gives no clue as to the race, it affords, nevertheless, like the Belgian

caves, an irrefragable proof that the middle stratum of Arcy, with its bones of ruminants and the reindeer, corresponds to that stratum of Lombrive in which the skull was found.

Let us now turn to Germany.

In a valley of the Düssel, near Elberfeld, in the so-called Neanderthal, which forms a wild fissure in lime stone, there was a little grotto, about fifteen feet in length, ten feet broad, and eight feet high, opening in an almost perpendicular rock 60′ above the level of the valley. From the top the cave could be reached by a steep path which led to a small ledge where the grotto opened. The Neander ravine has been used as a marble quarry, and the left side which contains the grotto is nearly exhausted. The progress of the quarry led to the exploration of the grotto. There was found in it a stone-hard layer of loam, presenting a horizontal surface without calcareous sinter, but with fragments of brown rolled gravel, a diluvial deposit which occurs in all caves and grottoes of the Düssel valley, and contains, in some places, bones of the bear, as in Sundwich and Hönnethal. In this ossiferous mud, containing rolled gravel, two feet below the surface were found the bones of a human skeleton, with the skull lying in the same horizontal plane towards the entrance. The loam adhered so strongly, that the workmen took no notice of the bones, but scattered them about, believing them to be the bones of bears, until Prof. Fuhlrott of Elberfeld, to whom we are indebted for an account of this discovery, declared them to be human, and saved from further destruction the cranium, the femoral and humeral bones, a clavicle, a portion of the pelvis, the scapula, and several fragments of the ribs. The bones adhere strongly to the tongue and are covered on the surface with minute spots, which, under the magnifying glass, proved to be groups of dendritical markings, as also seen upon the bear bones of the neighbouring caves. Though these markings afford no absolute proof of antiquity, such arborescent infiltrations of metallic matter have also been observed in Roman bones, and as dendrites may be rapidly formed under favourable circumstances by the introduction from the loam of salts of iron and manganese, they still furnish an important indication, inas-

much as the bones of the cave-bear and the elephant, imbedded in the same loam, present similar dendritic crystallisations. "This indication," says Fuhlrott, "is confirmed by the circumstance, that the country between the Düssel valley and the neighbouring railroad station, Hochdahl, to the level of the margins of the Neanderthal ravine, is covered with a stratum of loam fifteen feet thick, which seems identical with the loam of all the grottoes and caves which contained human bones. That this loam bed belongs to the diluvial period is, apart from other reasons, confirmed by the last palæontological discovery in that spot by the mammoth remains, which were found December 27, 1858, in one of the Dornap lime-stone quarries (on the Steele-Vohwinkel railroad), about thirteen feet under the surface in a fissure fourteen inches wide, which was filled up with a loamy mass, analogous to that of Hochdahl. These mammoth remains shew that the inclosing mass belongs to the diluvium. Now, since the Dornap (Devonian) lime-stone forms the eastern continuation of the Neanderthal lime-bed, and as the spot where the mammoth remains were found is scarcely more than four miles distant from the Neanderthal, it becomes more than probable that the respective loam deposits in the fissures and grottoes of both localities have the same geological origin, and both belong to the diluvial period. But if the mammoth remains are undoubted fossils, then the human bones imbedded in the same diluvial mass may also be fossil, and we are thus sorely tempted to assign to the human race, perhaps to a primitive form of it, as high an antiquity as to the antediluvian pachydermata."

The decomposing corpse was undoubtedly washed into the grotto along with the loam and the rolled gravel, when the waters stood high, and as there is no trace of a more recent deposition, and the age of the loam is sufficiently proved by the presence of bear and mammoth bones found in this loam, and as, moreover, this skull presents peculiar characters, which distinguish it from all modern skulls, there can be but little doubt that the owner of that skull lived at the time of the mammoth and the cave bear. We shall term this skull, to be described hereafter, the Neander skull.

There are, to my knowledge, no human remains at present known to which may be ascribed a higher antiquity. The human remains found by Esper and Rosenmüller, in the Franconian caves; by Schlotheim, in the gypsum quarries of Köstritz, in Saxony; the remains which Marcel de Serres, de Christol, and Tourtual, dug out from the caves near Montpellier, are either lost or inaccessible to examination. Concerning the structure of all these skulls, I found but one notice in a paper by Schaaffhausen, entitled, "Contributions to the knowledge of the oldest race skulls," according to which Link is said to have found amongst Schlotheim's collection a skull with a remarkably flattened forehead. In all these researches, particular attention must be paid to the age of the human bones, which must be inferred from the animal bones associated with them. In this respect we find, even in the few human cave skulls, from prehistorical times, important differences. Thus the Engis and Neander skulls belong to an earlier period; those of Lombrive to a later period of the same epoch. In all these cases the conditions under which the bones were found are identical. The human corpses were washed into the caves along with the animals they lived with, and imbedded in the same mud.

There are other caves which furnish decisive evidence, that they served as burial or fire-places, where, besides the remains, flint weapons, coals, and worked bones, are found intermixed with fresh bones, or such as served for food. One of the most interesting of such caves has been recently described by Lartet.

In the vicinity of Aurignac, in the department of the Haute Garonne, is a hill of nummulitic limestone, called the beech mountain. At present no beeches are found, nor exists there any tradition of their having formerly flourished there. On the slope of this eminence, about thirteen to fourteen meters above the brook, is seen the entrance to a grotto, about three meters wide and two and a-half meters deep. The entrance to this grotto was formerly concealed by a heap or *talus*. The sportsmen knew that there was a hole into which the rabbits escaped when pursued by the dogs. A labourer, employed to repair the neighbouring road, one day introduced his hand into the hole and extracted from it a large bone. He

at once suspected the existence of a cave, and having removed a portion of the *talus*, he came, after a few hours work, to a thin slab of sandstone, placed vertically, which completely, with exception of the hole used by the rabbits, closed the opening, which led to an arched recess containing a number of human bones. Amongst the bones extracted were two entire skulls, which afterwards could not be recovered. The workman talked of his discovery, the curious flocked to the spot, there was great agitation; and as nothing can be more disagreeable to the Imperial governors than agitation, the mayor of Aurignac ordered all bones to be collected and to be re-interred in the parish cemetery. Had it been a common provincial village mayor who gave such an order, constituting, as it were, a crime against science, we might have pitied his ignorance; but this undertaker, we are sorry to say, was a doctor of medicine! In short, the bones were interred after the mayor had ascertained that they belonged to seventeen different individuals; and when Lartet, after the lapse of eight years, visited the place, no man in the whole community could or would inform him where these bones had been interred, so that these relics, so interesting to science, seem lost for ever.

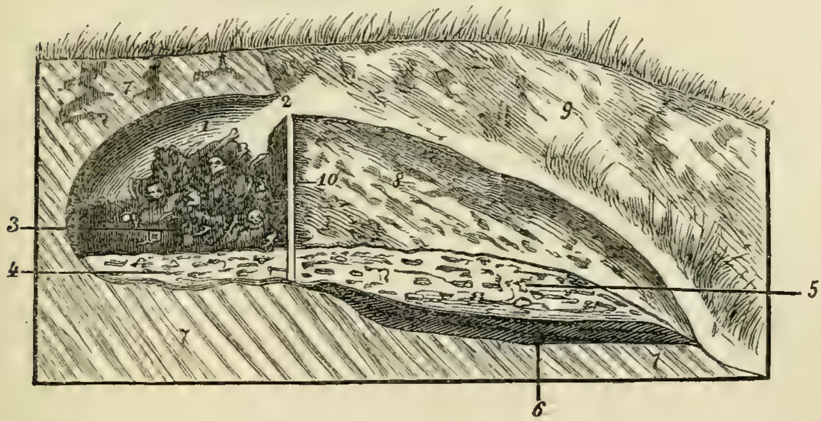
Besides the human bones were found some teeth of large mammals, distinguished by Lartet as the grinders of the horse and aurochs, canines of the hyæna and cave lion, and fox's teeth. There were also found small perforated discs, apparently made from the shell of a species of cardium, which could be strung together as a necklace.

When Lartet, in the autumn of 1860, visited the grotto, then only half a meter in height, there was on the floor a layer of loose earth, which contained some human and animal bones, as well as flint implements. This layer extended beyond the arched sepulchre, and it remained doubtful whether the slab of sandstone which served as a door, was fixed or only placed there. At all events the upper layer was the same within and without the cave, and it is probable that the slab was removed after every burial. From the dimensions of the grotto and the number of bodies, Lartet concluded that they had been placed in a crouching attitude, like the Peruvian mummies.

The grotto was subsequently, under Lartet's supervision, explored layer by layer, and yielded the following results :—

In front of the grotto the inequalities of the rock had, by slabs of sandstone, been transformed into a kind of hearth,

Fig. 85. Section of the Grotto of Aurignac.



1. The inner vault. 2. The rabbit-burrow which led to the discovery of the grotto. 3. Human bones. 4. Rubbish, with bones and implements inside the grotto. 5. Rubbish outside the grotto. 6. Deposit of cinders. 7. Rock. 8. Talus of gravel, which concealed the slab of sandstone, 10, Placed vertically against the entrance. 9. Slope of the hill covered with gravel.

upon which was a layer of ashes and charcoal, about fifteen to twenty centimeters thick.

The sandstone slabs, which formed this rude hearth, showed here and there the effect of the fire. The layer of charcoal thinned off towards the grotto, and did not actually reach it. In this layer were found many teeth of herbivora, and hundreds of fragments of bones, some of which were carbonised, while the greater part were manifestly broken and gnawed by large carnivorous beasts. As also coprolites of hyænas were met with in the same layer, Lartet concludes that the long bones had been broken by man for the sake of the marrow, and that the remains of his repast were taken advantage of by hyænas. This conclusion is supported by the discovery in the layer of ashes and charcoal of about 100 flint knives with which the incisions upon the bones were made. These flint knives were probably manufactured on the spot, as in the neighbourhood of the hearth were found the nuclei of some blocks from

s 2

which splinters had been struck off, and a round pebble with a central depression on each side, a portion of a kind of rock not found in this part of the Pyrenees. There were also found two roundish pebbles with angular facets which may have served as slingstones, besides a number of implements, arrowheads, and knives made of reindeer horn. There were also discovered the canine tooth of a young cave-bear singularly worked on the outside and perforated in its whole length, worked reindeer horns, and disjointed laminæ of a mammoth molar from which the enamel had been detached.

In the rubbish which covered the interior of the sepulchral vault were found, as already observed, some few human bones, the most finished flint implements, the best worked reindeer horns, some well preserved bones of herbivora neither broken nor gnawed, and a large number of teeth and jaws of carnivora. But nowhere existed any cranial fragments of mammals; and it was quite evident that the remains of carnivora had been introduced into the sepulchre for a special purpose.

Lartet gives a list of the animals whose remains could be identified. The list includes from eighteen to twenty foxes, five to six cave-bears and cave hyænas, three wolves, one to two badgers, and some few teeth of the cave-lion *(Felis spelæa)*, the wild cat, the pole-cat, and the common bear. Among the herbivora he found twelve to fifteen aurochsen *(Bison Europæus)*, as many horses, ten to twelve reindeer, which thus constituted the chief food of man in that region; whilst of the roe there were only three or four, and of the mammoth, the rhinoceros, the wild hog, and the gigantic Irish deer, there were scarcely any remains of each specimen. It appears that these few bones were those of swift animals as well as of the pachydermata, which could not at that period be easily overcome by man; for the bones of the rhinoceros, which were found split and deprived of their marrow, belonged to a very young animal.

There is no doubt that the interior of the grotto of Aurignac served as a sepulchre, whilst at the entrance there was a hearth. It is probable that teeth and jaws of the beasts of prey, which an individual had killed in his lifetime, were buried with him as trophies, or may be to provide him with aliment during his

voyage to another world, as is the custom with many primitive peoples. In any case, this grotto furnishes another proof that man was the contemporary of extinct animals, upon which he fed, and that consequently the age of mankind reaches back to a very remote period.

In the ossiferous caves of Brazil, explored by Lund with so much perseverance, there were also found amongst the remains of extinct animals human skulls with receding foreheads. These skulls, as far as I know, have not been closely examined nor compared with the races now inhabiting South America.

Is it necessary for me to enumerate all those caves, in which, it is true, no human bones were found, but the products of man's industry, flint and horn implements and hatchets, &c., among the teeth and bones of extinct animals in the same condition deep in the ossiferous loam, deep under the stalagmite? The conditions, with slight differences, are everywhere the same, so that the proofs would be mere repetitions. If the evidences could be refuted as regards one cave, it would affect them all. As such, however, is not the case; as the evidence is irrefragable not merely with respect to the explored caves of Italy, France, Germany, and England, but also as regards the caves in North and South America, we may confidently assert that the facts obtained from the exploration of caves and grottoes are sufficient to prove that man existed at the beginning of the diluvial period, and was the contemporary of the extinct animals.

LECTURE X.

Human Remains from Denise, near Puy.—Fraudulent speculations.—Diluvium in the Somme Valley.—Flint Implements.—Human Jaw.—Diluvium of Joinville.—Diluvium of Hoxne.—Brazilian Caverns.—Alluvium of North America.—Civilisation of Primitive Peoples.—Skulls of Engis and the Neander Valley.—Proportions of these Crania compared to those of living races of Mankind and Apes.

Gentlemen,—We have, in the preceding lecture, given an accumulation of proofs that man existed contemporaneously with the extinct animals in the so-called diluvial period. But as the deposits in fissures and caves always present some extraordinary mysterious character, it may not be out of place to examine such human remains as are found in alluvial formations, in the open soil, where we shall meet with some additional important facts in relation to the age of the strata.

In 1844 an account was published of the discovery of a human skeleton, or rather of several human bones, in a volcanic block, found in the vicinity of Puy, on the slopes of the extinct volcano Denise. The remains consisted chiefly of two pieces of the upper jaw, the frontal part of the forehead, some other cranial parts, a lumbar vertebra, a portion of the radius, and two metatarsal bones. The block itself consisted of light porous tuff, in which the bones are imbedded, and behind which is a harder stone, consisting of alternate layers of clayish lava. Blocks of a similar kind, a product of the last eruption of the now extinct volcano, are frequently met with in volcanic alluvia; they, perhaps, formed at first mudstreams, which, on drying up, became more condensed. In these tuff blocks, in the vicinity of the town of Puy, are found the mammoth and the rhinoceros with a bony nasal septum, whilst in the other tuffs, which evidently belong to older eruptions of the same volcano, other animals occur, which, according to French naturalists, belong to an older Fauna. The human bones found in Denise thus belong to the same period as the bones of the

Belgian caves, which were contemporaneous with the mammoth and cave bear. The bones are, unfortunately, insufficient to determine the primitive race of Auvergne. The preserved cranial bones do not, however, shew any great deviation from the form at present obtaining in that region. According to all appearance, for hitherto they have not been closely examined, they most closely resemble the cranial type represented in the caves of Lombrive.

No sooner was attention excited, and the importance of the Denise discovery established, than fraudulent speculation laid hold of it. There are, at present, blocks in the possession of some persons, into which the bones have been inserted artificially, and an eminent naturalist of that county, M. Bravard, informed the Geological Society of France that he had detected a skilful workman in the act of so introducing them. From this it has been inferred that the block first found was also a counterfeit, but its authenticity is now established. Cases of this kind need not surprise us. No sooner is a discovery made than collectors flock to the spot, the English specially, offering high prices. There are some quarries which yield the owner more by their petrifactions than by the building materials they yield. The greater the demand the higher the price, and the greater the inducement to deception and fraud. The workmen themselves now fabricate the desired articles, or produce something new, in which they are as inventive as were the monks of the convent Rheinau, who, of the slabs of Oeningen, with fossil fishes and salamanders, compounded the most fantastic creatures. A similar case occurred recently in Switzerland. When the railroad near Concise was in course of construction, there was found in the Lake of Neufchatel a pile structure of the stone period, from which were extracted a large number of bones of deer in all stages of workmanship. When the workmen, who at first took little notice of these objects, found out that antiquaries pounced upon them like hawks upon sparrows, they raised the prices, and when the articles became scarce they provided themselves with worked staghorns. Many an antiquary was thus taken in. Mr. Troyon, the conservator of the Museum of Lausanne, purchased in good faith

a whole collection of these articles and exhibited them in the Museum, where the fraud was detected by some more acute observers. This fraud, however, as little invalidates the genuineness of the first articles found, as the fabrication of old pictures, statues, and mosaics, which is now so successfully carried on in Italy, can diminish the value of the genuine original antiquities.

Let us return to our subject. The volcanoes of Auvergne and the Rhine, which in prehistoric times vomited forth mighty streams of lava and ashes, have become extinct since the time of the mammoth, cave bear, and the reindeer. The volcanic tuff, enclosing the above-named animals, is contemporaneous with the deposit in the caves. The fossil man of Denise is, however, as far as we know, the only human relic found in this tuff.

In the diluvium of France and England, on the other hand, have been found so many stone and bone implements, that they deserve our attention, as their discovery has given the first impulse to researches in this new direction. We may, however, observe at once that, excepting one lower jaw, the antiquity of which is still contested, no human fossil bones have been found in the diluvium, but only implements, so that the race question remains unsolved. It is just possible that some old graves, such as those discovered in Mecklenburg, of which more hereafter, belong to that period; but the contemporaneity is far from being established, and further researches are needed.

In the North of France, especially in Picardy, the soil is chiefly composed of white chalk, containing in its horizontal strata regular layers of flints. In former times, when flints, alike for purposes of peace and war, possessed a high value, which they retained until the invention of lucifers and percussion caps, there were in Picardy and the Champagne large flint manufactories which procured their material from the subsoil. We shall see that this manufacture of flint implements dates from the remotest antiquity.

This chalk formation was, no doubt, at a former period covered by tertiary formations, thus forming an almost uniform plateau which gradually thinned off towards the sea. These tertiary formations were mostly of a sandy nature, and thus it

was that every brook gradually washed off the tertiary formation and transformed its harder parts into rolled pebbles. Hence we only find the tertiary formation at a distance from rivers, specially from the main stream of the Somme, upon the plateau, and mostly covered by the old diluvium, a fatty clay or brick earth, itself mostly derived from the destruction of the tertiary formation, and forming an extremely fertile bed about five feet thick, which contains no fossils. Into this old diluvium, as well as into the tertiary strata, and deep into the chalk, have the streams and brooks dug their beds; and the valley in which each of these streams flows, a valley of comparatively considerable width, is thus bordered on both sides by a chain of hills, the slopes of which towards the stream consist of white chalk, above which at some distance is spread out the fertile loam, while beneath lie the sandy tertiary strata. The bed of the Somme, near Amiens, is nearly a mile in width, but enlarges considerably from below Abbeville down to St. Valery. In this river-bed, as well as in the neighbouring valleys, occur formations which are manifestly more recent than the excavation of the river bed, the tertiary strata, and the alluvial formation of the platform. These formations within the old river valleys claim our special attention, as they contain human remains.

Fig. 86 Section of the Valley of the Somme, at Abbeville, after Prestwich.

S. The river Somme. *M.* Sea-level. 1. Peat in the valley. 2. Subjacent Letten. 3. Flint gravel reposing upon chalk. 4. Grey diluvium, with bones and hatchets. 5. Calcareous loam or loess. 6. Brown clay and vegetable soil. 7. Chalk.

On the sides of the valley there are comparatively very slight deposits of rolled gravel, marl, sand and clay, forming two different terraces, to distinguish which a practised eye is requisite. In the lowest terrace, from twenty to forty feet thick, there is immediately beneath and upon the chalk a layer ten to fourteen

feet thick of coarse, white, chalky sand, with flints but little rolled, about three inches in diameter, intermixed with many flint balls, washed forth unbroken from the chalk, and forming a confused bed in which layers of fine sand alternate with sandy marl. In the fine sandy layers are frequently found sea- and fresh-water shells still existing in the district, excepting a species *(Cyrena fluminalis)*, which at present is only met with in the Nile and some parts of High Asia, namely in Cashmir. Here and there the fresh water shells are intermixed with the strand mussels of the sea which still live in a neighbouring canal, showing that the sea made frequent irruptions far into the land. Besides this, there are found in this inferior bed of the lower terrace, in immediate contact with the chalk soil, fossil bones, and, associated with them, flint implements, of which more anon. The bones found in this bed are generally those of the mammoth, the rhinoceros with a bony septum, the fossil horse, the aurochs, the gigantic deer, the reindeer, the cave lion, the cave hyæna, and other extinct cave beasts.

This older stratum generally presents an irregular surface, with eminences and depressions, as seen in all beds deposited by the irregular flow of the waters. Above it lies fine white silicious sand, with rounded pebbles and thin beds of marl, in which also here and there some fragments of the bones of extinct animals are met with. This bed has manifestly been deposited at a later period; it has a mean thickness of six feet, and contains no other petrifactions.

Upon this lies a bed of brown clay, mixed with a few angular flints, filling up the depressions in the surface of the second bed, and passing here and there into an ochrous sand which contains no fossils. The surface is even, and covered with a layer of common earth of considerable thickness. Old graves occasionally found in this terrace sometimes pass through the superior brown clay bed to the white sand bed, but never reach its bottom. They are known at once, being filled with brown earth and human bones.

The upper terrace is similarly constructed, so that it is not easy to point out any difference.

The central parts of the valleys are generally filled with peat

bogs, reaching occasionally a thickness of thirty feet or more. These peat moors have been distinguished as old and recent. The old peat bed is said rarely to be more than one meter thick. There are found in it in every direction trunks of alders, oaks, firs, hazels, and bones, specially of the beaver and the common bear. This old peat is in some spots covered with sand dunes. It reposes upon a bed of sand and gravel resting upon chalk, from which it is separated by a layer of brown or black impervious marly clay.

In our endeavours to decipher from the above description the history of the valley of the Somme, we arrive at the conclusion, that this valley was excavated after the deposit of the alluvia on the table land; that the terraces had at a later period been formed by smaller streams, after which a temporary increase of water in the streams caused these terraces to be washed off, so that they are only preserved in certain spots; that the rolled gravel and the marly clay which now form the bottom of the peat bogs, are the deposits of the waters which scooped the valleys, after which the formation of the peat commenced. The formation, however, of the old peat in the vicinity of the sea has frequently been interrupted by the irruption of the sea, which covered it with sand.

The alluvial formations upon the platform correspond with those which the Parisian geologists term *diluvium des plateaux*. The lower bed of the terraces, with the pebbles, large blocks, elephant bones, and flint implements, corresponds to the grey diluvium of Paris *(Diluvium gris)* ; the upper layer, with its silicious sand and gravel, to the red diluvium of the French *(Diluvium rouge)* ; the brown layer to loam or loess.

Must I repeat the touching story of how Boucher de Perthes, a meritorious but somewhat eccentric antiquary of Abbeville, first found the singular flints in the grey diluvium, how he went with his discovery a-begging from door to door, and found no hearing; how, at length, some of his neighbours, and next some Englishmen, became interested, until Amiens, Abbeville, St. Acheul, Menchecourt, and other localities of the valley of the Somme became the resort of geological and archæological pilgrims, who visited these places either to be convinced

or to gather new facts, whilst not a few allowed themselves to be overreached by the workmen, who soon established a regular manufactory of flint implements. It must be admitted that the coolness with which the news of the discovery was at first received, was partly due to the exaggerations of the discoverer, from which charge he is not altogether free even now; for he sees in some of these worked flints rude delineations of human and animal heads, and in others instruments for cutting the hair and nails. We may reasonably doubt whether art, in its rudest beginning, included hair-dressing in the primeval epoch of the human species.

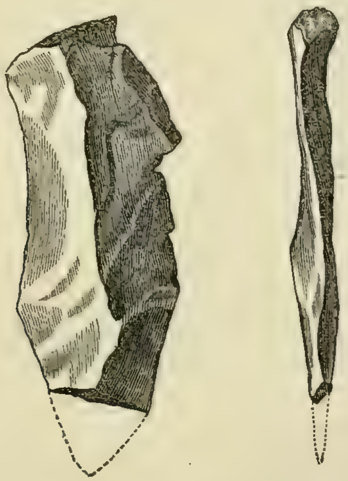
I shall pass over the desperate attempts made to explain away the formation of these implements. They afford a melancholy proof of that disposition to regain, at any price, even at the expense of common sense, a lost position. It is proved, beyond any doubt, that these flints have been fabricated by man's hand; that they owe their origin to no other cause; that they lie in beds which, since their deposition, have never been disturbed; and that they unquestionably date from the same period as that of the extinct animals.

Let us now examine the flint implements. They are very rudely fabricated, and manifestly split off from the flint stones found in the district. Two stones were struck against each other until one was shattered, and such splinters collected as appeared suitable for being worked. As the flint pebbles have a round or oval form, it is natural that the splinters should more or less exhibit the same shape, and that the centre of the pieces should be thicker, and present an edge lengthwise. Flint has nearly the same fracture as glass. On some of the stone hatchets is seen the crust which flints imbedded in chalk always present. These instruments were either not finished, or the workmen found that condition suitable for their purpose, and so left them as they were. The edges are mostly sharp. There can be no doubt but these implements have been manufactured on the spot, or in the vicinity, as they are but little rolled. This assumption is further supported by the circumstance that the hatchets are mostly found at the base of the formation in large quantities, as during the

few years that attention has been drawn to this subject many thousands have been extracted from the Somme valley. It is this quantity which affords additional evidence of their being worked, for a single sample may have been the effect of accident, but not so many thousands.

Three forms have been distinguished. The so-called knives or flakes (*éclats*) are the least worked; they are thin elongated pieces, with cutting edges, running to a more or less sharp point, and manifestly the result of few blows.

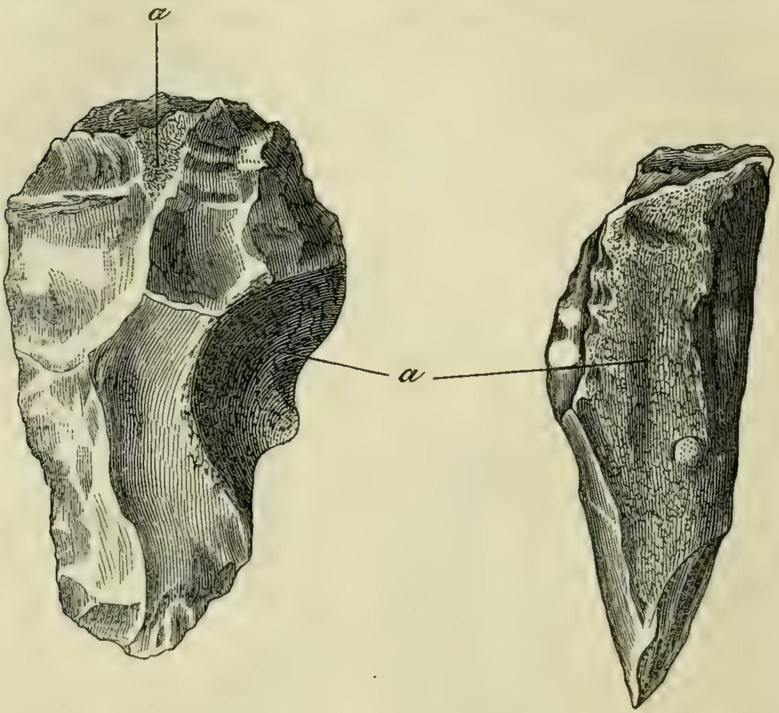
Fig. 87. Flint Knife in the Geneva Museum, presented by Boucher de Perthes. Surface and Profile.



Among the splinters caused by the breakage of large flints, such were selected as resemble the blade of a knife, which were used for cutting meat, skinning animals, &c., as is also shewn by the worked bones of which we have spoken, and which still shew the indentations made by their flint knives.

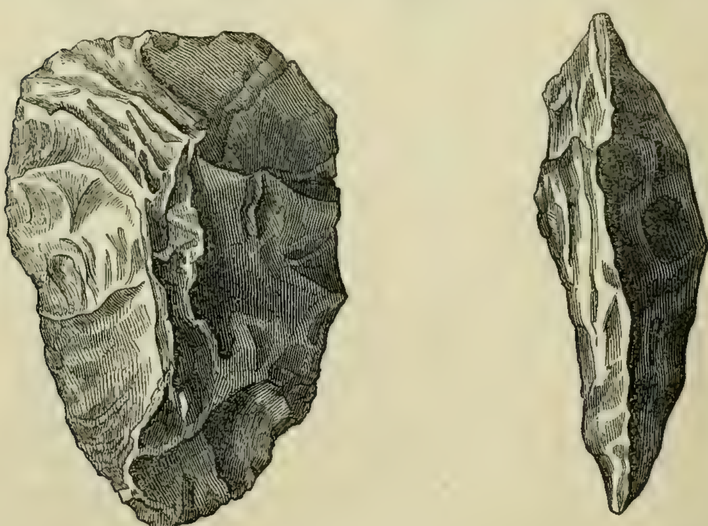
The two other forms are more finished; they are spear- or lance-shaped. The lance-shaped are longer, some eight inches in length, finely pointed, thicker, and more massive at the broad end, so as to form a sort of a handle. The instruments of oval shape have been mostly worked by gentle blows. From the form and workmanship, as well as from comparison with pieces of a later period, which are more perfect, it may be shewn that these implements served for wedges. The savages

Fig. 88. Oval-shaped Stone Hatchet, sharpened. Both from the same place.



a. The original Chalk Crust.

Fig. 89. Lance-shaped Stone Hatchets. Surface and Profile.



in the islands of the Pacific, who, when discovered, were ignorant of the use of metal; the Indians of North and South

America, all worked and made use of similar flint implements.

The condition of the stone hatchets found in the valley of the Somme also bears evidence of their great activity. As already observed, many of the implements are encrusted with the same film as the flint in its chalky bed. All those made from dark grey flint show also a coloration (called by the French *la patine*), more or less penetrating into the interior and corresponding to that of the gravel in the same strata. In some spots it is white, in others yellow or dark brown. This coloration extending to all the edges and surfaces, and penetrating equally into the interior structure, furnishes ample evidence that the period, during which the tools have lain in the strata, is of equal duration with that of the broken gravel forming part of the same bed. In some spots the surfaces have dendrites like those on the Neanderthal skull; these, however, furnish no absolute proof of great age.

Beside the stone hatchets no other traces of human industry were found excepting some small round bodies perforated in the centre, which are fossils found in the chalk, and known by the name *Coscinopora globularis.* At first it was suggested that the hole was artificial, until it was found that many of them still imbedded in the chalk were equally perforated; the central portion, being of a more spongy texture, had probably been scooped out during decomposition. As rows of them have been found in juxtaposition, it is probable that these bodies had been strung together as beads and worn as ornaments, which is the more likely, as some of these beads, belonging to a later period, have been found which were evidently artificially bored.

Human bones have long been sought for, but in vain, and Lyell, who possesses a mania for explaining everything, did not neglect this opportunity of writing an explanatory treatise on the absence of human fossils in the valley of the Somme. But at last a human jaw was found at Moulin Quignon, near Abbeville (March 29).

The jaw was carefully removed by Boucher de Perthes from the lowest bluish ferruginous stratum, resting immediately upon the chalk. One of the molars is still in the jaw, the socket of

the last molar, which must have been lost during life, was closed up, the other open alveoli were filled with sand. The

Fig. 90. The Moulin-Quignon Jaw, outside view, from M. de Quatrefages' photograph.

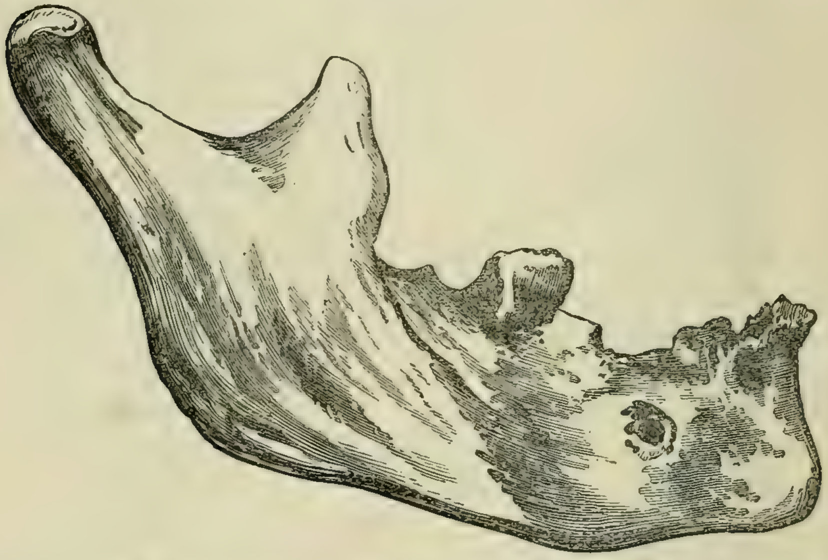


Fig. 91. The Moulin-Quignon Jaw, inside view, from M. de Quatrefages' photograph.

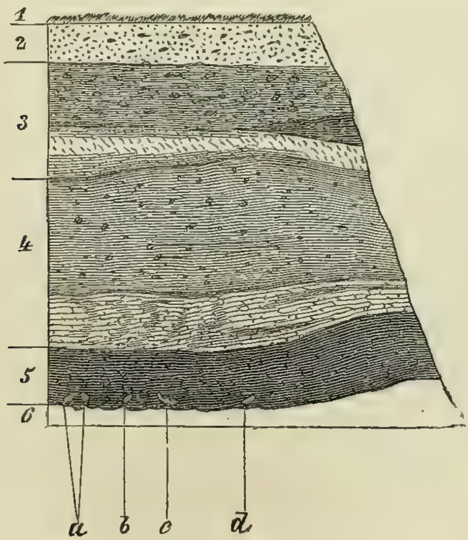
jaw had the same black coating as the hatchets found in the gravel. The form of the jaw presents many peculiarities.

The angle formed between the ascending and the horizontal ramus is very open, the ascending ramus very low and broad, its head uncommonly round, and the posterior margin curved inwards, as in the marsupials. All these characters may separately be met with in some European skulls, but they are never found in such combination. Doubts respecting the authenticity of this jaw, raised chiefly by English naturalists, have, after a long investigation, been removed, as we shall show hereafter. The jaw of Moulin Quignon is the first, and hitherto the only human fossil obtained from the stratified diluvium, and, from the combination of many characters, no doubt belongs to a peculiar race, which cannot be determined until more such discoveries are made.

The proceedings of the above congress excited general interest and gave rise to different interpretations. The members themselves did not seem quite clear as to the results obtained. Dr. Falconer, for instance, had no sooner crossed the Channel than he began to raise doubts against what he could not well deny in France in presence of the facts. I feel, therefore, bound to enter into further particulars concerning the points at issue.

The succession of the beds in the spot where the jaw was found is represented in the subjoined figure.

Fig. 92. Section of the Beds at Moulin-Quignon, after O. Dimpre.



		Thickness in metres.
1.	Vegetable earth - - - - -	0·30
2.	Grey undisturbed sand, with broken flints - -	0·70
3.	Yellow argillaceous sand, mixed with large and little rolled flints, below which is a bed of grey sand without flints -	1·50
4.	Yellow ferruginous sand, mixed with less thick but more rolled flints, below which is a bed of less yellow sand. In this bed Boucher de Perthes found fragments of a tooth of the Mammoth, and some flint hatchets -	1·70
5.	Black argillo-ferruginous sand, colouring and sticking to the hand; small pebbles, more rolled than in the higher beds. In this bed were found flint hatchets, and the human jaw. *a.* Marks the spot where Quatrefages found two flint hatchets in the presence of the Congress. *b.* The spot where Boucher de Perthes found a flint hatchet: and *c.* where he found the jaw, March 28, 1863. *d.* Is the spot where Dr. Falconer found another hatchet, April 14, in the presence of the Congress - - -	0·50
	Thickness of the alluvium - -	4·70
6.	A bed of chalk with an irregular surface.	

The objections raised by Elie de Beaumont, Perpetual secretary of the French Academy, deserve some special notice; in order to obviate misapprehension, I shall state them nearly in his own words: "I am of opinion," says this geologist, "that the alluvial deposits excavated from the gravel pit at Moulin-Quignon do not belong to the diluvium proper.

"In my opinion this apparent diluvial formation belongs to such deposits as I have formerly called alluvium. . . . . . These formations are synchronous with the formation of peat, and may, like it, contain human bones and the products of human industry; but such deposits which represent a kind of post diluvium, and are formed by detached fragments, transported by atmospheric influences, thunderstorms, snow, frost, and rain, may contain what the small diluvial deposits collected on the surface or the fissures of the rocks contain, namely, bones and teeth of elephants, etc., which belong to such bodies as are less apt to be destroyed by atmospheric influences or transportation.

"The men and elephants, the bones of which are found in such deposits, need not, therefore, have been contempora-

neous, and the different state of their cartilages appears to me to prove that they belong to different epochs. With regard to the flint implements, it seems to me natural to assign them to the stone period of the Swiss pile works. Since now these pile works are co-ordinate with the present level of the lakes, they must necessarily be post-diluvian, for in all the Swiss lakes, even those whose beds were not excavated by the erratic or diluvian phenomenon (if there be such), we can only date back the present level of the waters to the last effects of this mighty phenomenon, which left the bed of every lake in that condition in which we see it at present.

"I do not think that man co-existed with the mammoth; I still adhere in this respect to Cuvier's opinion. Cuvier's opinion is that of a genius, and has hitherto not been refuted."

Milne-Edwards, the celebrated professor of zoology, immediately replies, that he will give no opinion respecting the age of the beds at Moulin-Quignon, which concerned the geologists; but as regards the contemporaneity of man and the extinct animals, he must formally declare that it rests not merely upon the discovery at Moulin-Quignon, but upon a great number of facts ascertained in different countries.

Quatrefages also declares that, though for a long time he adhered to the view of Cuvier, he now entertained a different opinion.

According to all observations which I have cited in this work, there can really be no doubt on this subject. It is well known that more recent alluvial formations contain well preserved remains of destroyed beds; nothing, for instance, is more common than to find in the strata immediately overlying chalk, whether they belong to the tertiary or more recent formations, flints and silicious petrifactions from the chalk bed. Why, then, should not detached elephant and human bones be found intermixed in a recent diluvium? No doubt, such may be the case; but when such discoveries are made in the most different localities, when not merely rolled and worn away fragments of bones, but connected parts which manifestly must have been covered with flesh, are found associated with human bones and numerous remains of man's industry; if these

animal bones bear traces of workmanship, effected when they were in a fresh state, the aspect is changed. Were it possible to expunge from science the discoveries of Schmerling, Lartet, and many others, the jaw of Moulin-Quignon might, as is suggested by Beaumont, be considered a perfectly isolated case. But as these facts, perhaps unknown to the celebrated academician, are on record, it is impossible to treat a multitude of facts as a collection of exceptions.

With regard (apart from this jaw) to the parallelism of the stone hatchets of the valley of the Somme (and, by the way, of many other localities) with the pileworks of the Swiss stone period, it will excite both in the archæologist and palæontologist a smile of incredulity; in the antiquary, because the hatchets of the diluvium bear traces of different and more rough workmanship, whilst the Swiss implements indicate a much higher culture and a more recent epoch; in the anatomist, because the Swiss pile-works, as Rütimeyer has shown, present a different Fauna, in which there is no trace of extinct species, and which are perfectly distinct from those of the diluvial deposits. Whoever has read with attention the accumulative evidence given in a previous lecture, will find that I need not here prove again that the ingenious opinion of Cuvier, if it was such, has been in every respect refuted, and that the parallelism of the deposits of the Somme valley with the Swiss pileworks has turned out an unfortunate attempt void of any foundation.

We shall pass on now to the geological aspect of the question. I shall here summarise the assertions of Elie de Beaumont, and those of his opponents whose names are of not less weight in geology.

In a note read August 10th before the French Academy, Elie de Beaumont expresses himself thus:—"My theory rests chiefly on the distinction between the real or Alpine diluvium and certain gravel deposits which, like those of Moulin-Quignon, more or less resemble the diluvium.

"I attribute the origin of the latter to the effect of *still acting forces*, the action of which has, in my opinion, been momentarily interrupted by the diluvial phenomena, whilst other

geologists, in opposition to my opinion, ascribe even the diluvium to still acting forces. Reference has been made to present agents, only in another form than mine; the origin of the sandbank of Moulin-Quignon has been ascribed either to the action of floating iceblocks stranded in the Somme creeks, or to the various level-changes of the general mass of the continent. It does not seem to me justifiable to assume such grand phenomena for the explanation of such small effects, but I must be permitted to observe, that, if the sandbank of Moulin-Quignon really owes its origin to either of these two different phenomena, it manifestly does not, in my opinion, belong to the real diluvium.

"It is equally manifest that if this same sandbank of Moulin-Quignon is the product of a mixture of the elements of the grey and the red diluvium, it cannot belong to the grey diluvium, which is the proper alpine diluvium, and which, I agree with Cuvier in considering as corresponding to the extinction of the fossil elephant and as preceding the apparition of man.

"Attempts have, nevertheless, been made to prove that I am wrong in distinguishing the gravel of Moulin-Quignon, as well as many other deposits of flint, sand, and loam upon the platforms of Picardy, from the Alpine diluvium, and my views have been criticised because I very simply had recourse for the formation of these deposits to thunderstorms, frost and snow as the acting causes. I shall oppose to these critics a few ciphers.

"1. The sandbank of Moulin-Quignon lies, according to Boucher de Perthes, thirty meters above the level of the Somme, near Abbeville, consequently thirty-nine meters above the level of the sea. At a distance of less than two kilometers there are spots which, according to the map, have an elevation of sixty-one, sixty-three, and sixty-seven meters; at a distance of less than three kilometers there is one spot eighty meters, and at five kilometers are spots one hundred meters high. Taking into consideration the difference of elevation in proportion to distance, it will be found that the declivities from these points towards the sandbank of Moulin-Quignon all exceed the hundredth or 0, 34′ 22″, 58, that is to say that this fall is ten times

greater than the upper limit of the fall of the navigable rivers, and that this fall even exceeds that of the Isere, Arve, and Bruche in the Vosges, where these rivers, in the vicinity of their sources, flow with great rapidity, causing great devastations. All that is required is a heavy fall of snow or rain for the waters to effect similar devastations upon the undulating and loosely connected stony platforms of Picardy. Who could thus undertake to determine the limits of the greatest effects of this kind, which might have been produced on the environs of Abbeville since the stone period?

"It has been particularly pointed out that the sandbank of Moulin-Quignon is older than the peat of the banks of the Somme. This gravel deposit seems indeed to date from the stone period, whilst the peats of northern France are partly more recent than the Roman roads. If this be true, it is easily understood how the bones of the elephant and the rhinoceros may have undergone the removal which produced these and other deposits. They were then less petrified and less fragile than now; it remains nevertheless true, that the deposit at Moulin-Quignon, as well as the peats, have been formed by still acting causes, and belong, like the peat, to the present period.

"This gravel bank is composed of such variable deposits, which have been formed and are still forming on the surface of the earth by the agency of atmospheric influences, and which I designate by the name of alluvium of the slopes, in contradistinction to the fluviatile alluvium which forms the planes of the valleys. The alluvium on the slopes is very abundant in the north of France on account of the composition of the tertiary strata covering the chalk, in the mass of which the undulations of the ground enter.

"The alluvia on the slopes are forming daily during every fall of rain; some are formed in the garden of the Luxemburg, where the sand is scattered upon the paths, expressly as it were, to produce this little phenomenon. The alluvium on the slopes, that in the valleys, and the peats, are to be considered, in their totality, *essentially synchronous.*

"I will not enter into further particulars, but wait until the

jaw found at Moulin-Quignon has been analysed. I find, with Boucher de Perthes, that this analysis can afford no absolute solution, but I also share the opinion of the English savants, that the analysis of a bone, found in a doubtful position, is essential. The natural chronometer, such as the Dünes, the river-deltas, and the waterfalls, yield no absolute measures. The disappearance of the animal matter of a bone, is in itself a kind of natural chronometer, which, though it must be reduced to its fair value, is not to be neglected. I should be glad to see the jaw of Moulin-Quignon chemically compared, not only with fossil bones from the real diluvium, but with human bones, extracted from Gaelic or Gallo-Roman graves, and also with bones preserved in the catacombs of Paris."

Before proceeding further, I beg to offer a few remarks. As late as in the month of May, Elie de Beaumont asserted the synchronism of the peat and the gravel bank of Moulin-Quignon, and supported his view by the circumstance that human bones, wood, horn, stone, bronze, and iron implements have all been found in the peat. But, it seems, in the month of August, Moulin-Quignon becomes considerably older, but still remains in the same epoch, being thrust back to its beginning, the stone period, whilst the peat is advanced to the Roman period. It would be just the same to assert that Homer and King Otto were contemporaries because they belong to the same epoch, namely, the historical period of the Greeks.

Elie de Beaumont goes further. Moulin-Quignon is formed by still acting forces; the Alpine diluvium, on the contrary, is formed by other causes which momentarily interrupted the forces still acting in nature. Here is the rub. The present theory is that the diluvial period was of a very lengthened duration, and also that the present forces, glaciers, and waters, were in continued action, and that the diluvial period merged into the present without any perceptible interruption, and that, as we have shewn, the extinct animals died off very gradually, or retired, or were transformed into present species. The whole theory of Elie de Beaumont, regarding the Alpine diluvium, is founded upon an error of fact.

He has mistaken beds of *Nagelfluhe* (conglomerate of the

Alps), interposed between molasse strata, for diluvium, and has compared these beds, for which no fossils have yet been found, to the alluvium of the valleys where elephant bones have been met with. Hence this transposition of the diluvium into another epoch; hence this repudiation of still acting forces, as regards the above formations, for which he invokes unknown forces, which cannot at present be traced in nature.

As regards the slopes, there is a small point which must not be forgotten, namely, that the motion of water does not merely depend upon the fall, but also upon the mass, and that a navigable river flows down more rapidly than a small brook, and that rain water remains, to a certain extent, stationary.

With respect to chemical analysis, it may be said that the amount of organic matter only then furnishes a kind of natural chronometer when the respective bones are found in the same positions. If this be not the case, the chemical analysis has scarcely any importance, as those influences, which deprive the bones of their animal matter, act with greater intensity in one locality than in another.

The note of Elie de Beaumont, which we have rendered verbatim, is partly an answer to the communication of Hébert, laid before the academy in May, which I also subjoin. Hébert is intimately acquainted with the environs of Paris, and has, with other geologists, taken part in the Scientific Congress.

"The celebrated Secretary of the Academy of Sciences," writes Hébert, "ought to have noticed that we were specially occupied in investigating this question; that we are far from confounding the various accumulations of conglomerates; that we have shirked no difficulties; but that these difficulties do not invalidate the facts that man has existed in France since the beginning of the quaternary or diluvial period.

"With regard to the special locality of Moulin-Quignon, I have declared at Abbeville, that this conglomerate, consisting partly of broken or entire and frequently large flints, which seem to have come from the subjacent chalk, and are cemented together in a brown firm clay, which here and there contains sandy parts; I have declared, I say, that this formation does not, in my opinion, belong to the lower diluvium, which occurs

at St. Acheul, near Amiens, at Menchecourt, and other localities in the vicinity of Abbeville, and in which flint implements are found associated with the bones of the mammoth and rhinoceros tichorhinus.

"I therefore consider the deposits of Moulin-Quignon of a more recent origin, and incline, in this respect, to the opinion of Elie de Beaumont; but this learned geologist adds, that this deposit is synchronous with the formation of the peat, with which I cannot agree. The stratification at a much higher level, the nature of this stratification which indicates the action of water in rapid motion, do not admit of a relation between the phenomenon to which this deposit owes its origin, and the conditions which gave rise to the peat. The peat formation is, in my opinion, much more recent, and in it the waters present relations similar to the present, and which would be vainly sought for in the conditions which may be inferred from the flint deposits at Moulin-Quignon.

"I consequently rank this formation among the diluvium, but I have declared on the spot that I cannot exactly determine its constitution, as may be done with the well known deposits of Menchecourt and St. Acheul.

"To render the subject more plain, I crave permission to describe the phenomena of the diluvium in the north of France as established by geologists who have specially studied this subject.

"1. Excavation of our present valleys by erosion, a work of long duration, which required large masses of water.

"2. Development of the Fauna of the mammoth upon the so formed soil of France, which was covered with forests inhabited by the elephants and rhinoceros, forests of which scarcely any traces are left, whilst the animals which inhabited them have left their bones in the soil.

"Formation of the lower alluvium of our valleys, by streams, gravel below, sand above, with numerous relics of mammoth, rhinoceros tichorhinus, and flint hatchets, in the valley of the Somme. These deposits have filled up the previously scooped out valleys to a height of ten to fifteen meters, so that at Paris they rise thirty-five to forty meters above the level of the sea.

This portion of the alluvium is, on account of its colour, frequently called *grey diluvium*.

"3. Deposition of calcareous loam, called *loess*, which always contains lime knolls of the same shape, whether on the banks of the Rhine or at Paris, which overlies the preceding stratum, and marks a new phasis in the quaternary period.

"4. Formation of a gravelly deposit, the broken flints of which are cemented in red loam and quartzose sand, which contains no organic remains, is never clearly stratified, and lies partly upon the grey diluvium, partly upon the loess, as may be plainly seen in the vicinity of the new church of the Quartier de Deux Moulins, or upon the *calcaire grossier*, as may be seen on the platform of Maison Blanche and Montrouge.

"This deposit, usually called the *red diluvium*, which was previously, but erroneously, believed to be overlaid by the loess, lies mostly in channels, which are scooped out in the subjacent strata. All geologists know the singular bag-like depressions, which sometimes form well-shafts of five, ten, and fifteen meters in depth, intersecting both solid and moveable stone masses. These also are the effects of different phenomena of the quaternary period.

"When the subjacent diluvial strata, where they are in contact with the deposit, show no excavation, there are seen in the bottom one or two horizontal layers of firm brown or reddish clay, which sometimes contains a layer of ferruginous sand; and if bag-shaped depressions are present, this clay lines their walls, and thus envelopes the red diluvium, which it separates at the same time from the loess and the grey diluvium.

"The red diluvium spreads generally over the ground and the side walls of our partly filled up valleys; and rises in the vicinity of Paris to a height of at least sixty-five meters, but does not reach the heights attained by the loess.

"5. The surface of the red diluvium was itself washed off by the waters, which stratified its upper masses, and mixed it with grey loam. This deposit is still seen at the gate of Ivry.

"6. After these successive processes our valleys were again scooped out, but manifestly under new conditions. The deposits hitherto mentioned adhered to the walls of the valleys,

and the form of the ground surface became what it is now; though in these newly scooped out valleys numerous other geological processes took place, the investigation of which has scarcely commenced, but which, unquestionably, assign this final excavation to a very remote period.

"The grey and red diluvium are found with all their characteristics at St. Acheul, Menchecourt, and in many other places of the Somme valley; loess also occurs there, but in a very rudimentary form.

"The numerous flint-hatchets which testify to the existence of man in the beginning of the quaternary period, have been found in the grey diluvium, which is covered by its double undisturbed mantle.

"This deposit of Moulin-Quignon shows neither the characters of the grey nor of the red diluvium, but seems to be the result of a mixture of both, produced by disturbed waters; perhaps, by the same waters which scooped out the valleys.

"The last excavation was, perhaps, not a simple phenomenon; for the deposit of Moulin-Quignon is, as has been shown, intersected by vertical, natural shafts, resembling those produced by the red diluvium; but differing so far that the latter, as seen at St. Acheul and Paris, are filled with the red diluvium, whilst those of Moulin-Quignon are filled with a manifestly more recent clayish matter, resembling vegetable soil. This is, perhaps, an indication of a seventh phase in the quaternary period.

"The formation of the peat deposits must, in my opinion, be placed in an epoch subsequent to the above periods.

"In conclusion, I would just observe that the natural shafts, which intersect the gravel brook of Moulin-Quignon, can no ways be considered as having favoured the introduction of the jaw in question to the bottom of the deposits."

"The jaw was situate in a bed of black flint, perfectly distinct from the shafts, and the ferruginous substance had filtered through a fissure which pervades the whole mass from the surface down to the bottom, and which was itself filled with the same ferruginous mass, which it had carried down at

an indefinite, but at all events very remote period. The coloration and the incrustation of the jaw is accordingly a pure accident, but just on that account a guarantee against deception."

So far Hébert. We learn from it that the Parisian geologist, like ourselves, considers the diluvial period to have been of long duration, during which a number of phenomena succeeded each other, which required long periods of time. There is no question here of supernatural forces no longer acting, which are imagined only by such as cannot convince themselves that slight forces may, within a proportionate length of time, produce extraordinary effects. The position of the loess immediately upon the grey diluvium does not seem so strange to us; it may be parallelised with the loess at Cannstadt, so rich in bones of the elephant.

The following is a report of the concluding part of a Lecture delivered by M. D'Archiac, Professor of Geology in the *Jardin des Plantes*, on the 19th of June.

"Whatever be the authenticity ascribed to the human jaw of Moulin-Quignon, this discovery possesses only a secondary importance. It is a very simple fact, confirming other proofs, which by their number and universality have a much greater value. If the flint hatchets cannot be ascribed to accident; if they are really the products of human industry, however rude; if they must be held to furnish as irrefragable evidence for the existence of man before the formation of these deposits, as the bones of the mammoth, the rhinoceros, the hippopotamus, and of the cave lion, bear and hyæna, furnish for the existence of these animals, it becomes of little importance whether or not the remains of man are found in these deposits.

"The question is answered by the fact itself, and it is of secondary importance whether the sand and gravel of Moulin-Quignon are quaternary or not. The essential result, the theoretical point which predominates over all others, namely, the antiquity of man and his co-existence with the extinct species of large mammals, loses nothing of its value, if it be founded only upon the products of human industry, instead of the discovery of human skeletons."

"What has been said of the caverns of Liege, and what we shall say, is quite sufficient to answer satisfactorily the other part of the question.

"From the facts before us we cannot, in the present state of our knowledge, but assume, that the flint hatchets of the environs of Amiens and Abbeville are situated in undisturbed, essentially quaternary beds, along with the bones of extinct species, and, unless peculiar circumstances come to light, we must also assume that the jaw of Moulin-Quignon dates from that period.

"We must here touch upon a point, hitherto but little noticed; I mean the determination of the age of these deposits, or rather of the rank they occupy in the quaternary series. To what time of this period, disturbed by so many phenomena, do these beds correspond?

"This determination appears to us at present easy, unless we search for comparisons in the south [in the Alpine diluvium, C. V.], where they do not occur, and where we cannot estimate their value; but when we proceed to the north-east, the Netherlands, where the whole quaternary series stands in its true relation to the upper tertiary strata, both above and below the present sea level, or still better, when we proceed more northwards to the eastern counties of England.

"The deposits of clayish, sandy or flinty conglomerates, which are found in the basin of the Somme and in all the small brook-valleys which run from the Oise direct to the sea, all lie directly upon the chalk, and, excepting those cases where lower tertiary formations interpose, we see no intermediate deposit which may enable us to estimate the immense time which must have elapsed between those deposits which are at present superimposed upon each other.

"But on the other side of the Channel, the flint hatchets, which are identical with those of the Somme valley, lie in fresh water strata deposited in the cavities of the boulder clay. This is shown by the sections in the environs of Hoxne in Suffolk, Bedford, and the coast of Norfolk, near Mundesley. These sections prove that the fresh-water formations are more recent than the quaternary marine deposits of England, Scotland, and

Ireland, and consequently much younger than the Norfolk crag, the accumulations of bones of the *Elephas meridionalis* and *antiquus*.

"What is the animal world which characterises the beds in which traces are found of a rude industry the genuineness of which cannot be easily doubted?—land and fresh water shells, which, with few exceptions, still inhabit these regions, *pachydermata*, ruminants, and *carnivora;* namely, *Elephas primigenius* and *antiquus, Rhinoceros tichorhinus, Hippopotamus major, Cervus tarandus, Cervus megaceros, Bos primigenius* and *moschatus, Equus fossilis, Felis spelæa, Hyæna spelæa, Ursus spelæus, etc.* That is to say exactly that assemblage of species which we find in the fluvio-marine beds of Menchecourt, in the sandy and flinty alluvium of localities near Abbeville and Amiens, as well as in the valley of the Oise near Chauny.

"The analogy of these *Faunæ* on both sides of the Channel is still more strikingly proved by the occurrence near Menchecourt of the *Corbicula consobrina* or *fluminalis,* which occurs from Grays Thurrock, on the left bank of the Thames, up to Hull on the Humber, and is also found in the borings of Ostend.

"The remains of this Fauna of invertebrate and vertebrate animals were found in the great deposit of sand, clay, and rolled flints, which extends over the east and south of England, and which there, as on the continent, was in some places succeeded by a gravelly clayish deposit which corresponds to the older alluvium.

"In now comparing the results obtained on the other side of the Channel with the deposits of the Somme valley, we must necessarily consider the latter as not much older than the fresh water formations of the south of England, and contemporaneous with such strata as beyond the Channel contain the Fauna of those large mammals which lived during the quaternary period. The deposits of the Somme valley and the basin of the Oise are thus younger than the boulder-clay, than the Norfolk crag, and belong in fact to the phenomena which occurred in the second glacial period.

"Thus, on the one hand, the comparison of these deposits with those of the adjoining departments in the east, where the

relation of the strata to each other is more evident, permits us to determine the period to which they belong; and, on the other hand, this comparison with those in Belgium, England, and Holland points out to us the place they occupy in the series of deposits of this period.

"We may, therefore, with Worsaae, distinguish two stone periods. The one, *antediluvian*, characterised by rudely hewn flints, precedes these last quaternary deposits; the second, the later or *pre-historic* period, the weapons and implements of which indicate a less barbarous condition, comprehends the time when the population in Denmark accumulated the kitchen-middens, and that of Switzerland, Ireland, and other regions built the pile works."

The reader is now, from these extracts from Elie de Beaumont, Hébert, and d'Archiac, enabled to draw his own conclusion. As far as I am concerned, I am glad to find that I, simultaneously with d'Archiac, and quite independently, have arrived at the same results, namely: that the appearance of man on the continent (independent of Desnoyers' discoveries, which were then unknown to us) occurred in the period after the deposit of the boulder-clay.

You may easily imagine that the search for stone hatchets and flint tools as found in the valley of the Somme, extended soon to other parts. Similar discoveries were presently made in other spots. If I preferentially mention those made by Gosse in the neighbourhood of Paris, the reason is, that the stratification has been closely examined and determined. Charles D'Orbigny thus describes the section of the diluvium at Joinville, about six miles from Paris:—

Upon the fresh water chalk of St. Ouen, which belongs to the tertiary formation, rests a layer of about two meters, seventy centimeters in thickness, of so-called grey diluvium, with granitic pebbles, intermixed with large erratic blocks, in which, besides bones of mammals and teeth of the mammoth and rhinoceros, are found fragments of sea- and river-shells from the subjacent tertiary cretaceous strata. Upon this grey diluvium reposes a bed of white marly sand, about seventy centimeters thick, in which are found marly knolls, as in the

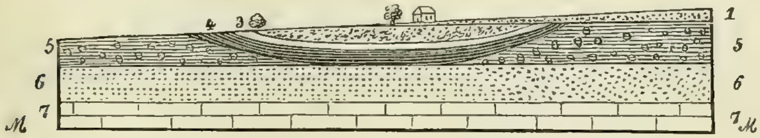
loess; and which contains, besides some fragments of mammals and reptiles, a large quantity of well-preserved land and fresh water shells, of which thirty-seven species have been determined, all of which still occur in the surrounding country, or in the south of France. These shells were, no doubt, deposited in a lake, which extended far beyond both banks of the Seine. Above the fresh water stratum lies another of grey diluvium, half a meter in thickness, containing granitic and porphyritic pebbles, but only a few fragments of fresh water snails, which seem to have been washed up from the subjacent stratum. Then comes a marly sandy layer of grey colour, with but few pebbles, without shells, seventy-five centimeters thick, and then comes the red diluvium of quartzose sand with pebbles, for which the chalk flints and the granite porphyry of Morvan have furnished the materials, which are coloured and cemented by the red ferruginous marly clay. This red diluvium, which thus partly consists of the same elements as the grey diluvium, reaches a thickness of seventy centimeters, and lies immediately beneath the loam or loess, which is here only thirty centimeters thick, though in many places much thicker, and covered by vegetable soil. In the lowest stratum of the grey diluvium in a suburb of Paris, at La Motte Piquet, Gosse found, amidst numbers of bones of the elephant, rhinoceros, and the horse, flint hatchets of the same kind as those of Amiens. One of these hatchets was attached by sand to a bone, so that there was no doubt that both were imbedded together.

Since that time a number of similar discoveries have been made in England, of which I shall only mention such as demonstrate the parallelism of the respective beds with those of France.

In 1801 John Frere communicated a paper to the English Society of Antiquaries, in which he reports that he has found, at Hoxne, near Diss, in Suffolk, worked flints at a depth of twelve feet in a stratified soil, which had been dug up for brick earth. Under a foot and a-half of vegetable earth was clay seven and a-half feet thick, and beneath this a layer of white fine sand, one foot thick, with shells, and under this two feet of gravel, which

contained the worked flints. Frere found also in the horizontal strata the jawbones and teeth of a large animal unknown to him; and saw five or six hatchets within the space of a square yard.

Fig. 93. Section at Hoxne, after Prestwich.



M. M. Sea-level. 1. Higher level sand overlying the basin. 2. Upper sand of the basin. 3. Lower sand with bones and hatchets. 4. Peaty clay for brick-making. 5. Boulder clay. 6. Sand and gravel. 7. Chalk.

Prestwich very recently examined this spot, and found the pit from which some hatchets were extracted, but no bones. Among the bones found there at an earlier period, were those of the elephant, the horse, and the deer. A minute examination established the fact that the chalk at the bottom is here covered with sand and gravel, upon this lies the lower glacial drift, which extends over nearly the whole of England and Scotland, namely, boulder clay and large blocks, which came from the north, specially from Norway. In this clay a basin seems to have been scooped out, the lowest bed of which is formed of a peaty and clayey stratum, impervious to water. In this black stratum fragments of the oak, yew, and fir have been recognised. Upon this bed lie the sand and gravel which contain bones of mammals, stone hatchets, with fresh water shells, amongst which the common river shell, *valvata piscinalis,* abounds; nor are the common pond snails wanting. Finally, this fresh-water basin is overlaid by a layer of sand and gravel of apparently very recent origin.

Similar discoveries have been made in other English counties. I shall not dwell on these, but would merely draw your attention to the fact that all these beds are deposited above that clay stratum, with pebbles and blocks, which the English term glacial drift, or boulder-clay. Whilst in all localities in France where these implements are found, one stratum, corresponding to the glacial drift formation, is entirely absent, or at

least not demonstrated, it is plainly seen in England, and may, therefore, serve for comparison with the discoveries in Switzerland, where glacial formations play an important part. I must also observe that in some beds in England, in conjunction with the bones of the mammoth and the rhinoceros, have been found bones, not only those of the reindeer, but also of the musk-ox; and that remains of this animal, which has now retired to Northern America, on the confines of the Arctic region, have also been found in the old alluvium of the Kreuzberg near Berlin, as well as in the valley of the Oise, at Chauny in France—another proof of the retreat of the diluvial Fauna to the north.

Having thus treated of the remains found in caves and the diluvium in Europe, which prove man to have been the contemporary of extinct animals, we may be permitted to cast a glance at what has been done in other parts of the world. I must here mention, in the first place, the Brazilian caves, which have been so successfully explored by Dr. Lund. The circumstances were almost entirely the same as in Europe. There were the same deposits, the red ossiferous clay covered with stalagmite, and the caves abounding with animal bones, mostly belonging to species now extinct. But these extinct species are as closely allied to those which at present exist in South America, as the cave-bear and the cave-hyæna is to the now existing bear and hyæna. The peculiar character which distinguishes the South American Fauna has been preserved. There are marsupials, antbears, lamas, armadilloes, as they still exist in South America. It is probable that when investigations shall be carried on by as many inquirers as is the case in Europe, the list of these peculiar species will be considerably enlarged. Be this as it may, this much is certain, that even in Brazil man was the contemporary of the extinct animals, and that the human remains found by Lund were in the same condition as those of the extinct animals. Unfortunately Dr. Lund's crania have not, as far as I know, been closely examined. According to one observer they possess the type of the American skulls, which, in my opinion, does not amount to much, as a great many different types occur in

America. There are prognathous and orthognathous crania, dolichocephalic and brachycephalic skulls even amongst the existing Indians.

In Australia, where cave deposits of extinct marsupials are found; in New Zealand, where the bones of those extinct gigantic birds, the moas, are found in large quantities, exist as well the most convincing proofs of the co-existence of man with extinct species of animals. We do not attach much weight to the moa, as there are traditions among the Indians of their having fought them, so that the species appears to have been but recently exterminated.

The alluvial formations of North America also show that man was the contemporary of extinct animals. Lyell reports nearly as follows: "At Natchez there is a fine range of bluffs, several miles long and more than two hundred feet in perpendicular height, the base of which is washed by the river. The lower strata, laid open to view, consist of gravel and sand, destitute of organic remains, except some wood, silicified corals, and other fossils, which have been derived from older rocks, whilst the upper sixty feet are composed of yellow loam, presenting, as it wastes away, a vertical face towards the river. From the surface of this clayey precipice project in relief the perfect shells of land snails, of the genera *Helix*, *Helicina*, *Pupa*, *Cyclostoma*, *Achatina*, and *Succinea*. These shells, of which we collected twenty species, are all specifically identical with those now inhabiting the valley of the Mississippi.

"The resemblance of this loam to the fluviatile silt of the valley of the Rhine, between Cologne and Basle, which is generally called 'Loess,' and Lehm is most perfect.

"In both countries the genera are the same, and as, in the ancient alluvium of the Rhine, the loam sometimes passes into a lacustrine deposit, containing shells of the genera *Limneus*, *Planorbis*, and *Cyclas*, so I found, at Washington, about seven miles inland or eastward from Natchez, a similar passage of the American loam into a deposit evidently formed in a pond or lake. It consisted of marl, containing the shells of *Limneus*, *Planorbis*, *Paludina*, *Physa*, and *Cyclas*, specifically agreeing with the testacea now inhabiting the United States. With the

land shells before-mentioned are found, at different depths in the loam, the remains of the mastodon; and clay immediately under the loam, and above all the sand and gravel entire skeletons of the *Megalonyx*, associated with the bones of the horse, bear, stag, ox, and other quadrupeds, for the most part, if not all, extinct species. This great loamy formation, with terrestrial and freshwater shells, extends horizontally for about twelve miles inland or eastward from the river, forming a platform about two hundred feet above the great plain of the Mississippi. In consequence, however, of the incoherent and destructible nature of the sandy clay, every streamlet flowing over what must originally have been a level table land, has cut out for itself, on its way to the Mississippi, a deep gully or ravine.

"This excavating process has, of late years, proceeded with accelerated speed, specially in the course of the last thirty or thirty-five years. Some attribute the increased erosive action to the partial clearings of the native forest, a cause, of which the power has been remarkably displayed, as before stated, within the last twenty years in Georgia. Others refer the change mainly to the effects of the great earthquake of New Madrid, in 1811-12, by which this region was much fissured, ponds being dried up and many land-slips caused.

"In company with Dr. Dickeson and Colonel Wailes I visited a narrow valley, hollowed out through the shelly loam, recently named "the mammoth ravine," from the fossils found there. Colonel Wiley, a proprietor of that part of the State of Mississippi, who knew the country well before the year 1812, assured me that this ravine, although now seven miles long, and in parts sixty feet deep, with its numerous ramifications, has been entirely formed since the earthquake. He himself had ploughed some of the land exactly over one spot which the gully now traverses.

"A considerable sensation was recently caused in the public mind, both in America and Europe, by the announcement of the discovery of a fossil human bone, so associated with the remains of extinct quadrupeds in "the mammoth ravine" as to prove that man must have co-existed with the *Megalonyx*

and its contemporaries. Dr. Dickeson showed me the bone in question, admitted by anatomists to be part of a human pelvis, being a fragment of the *os innominatum.* He felt persuaded that it had been taken out of the clay underlying the loam, in the ravine alluded to, about six miles from Natchez. I examined the perpendicular cliffs which bound a part of this watercourse, where the loam, unsolidified as it is, retains its verticality, and found landshells in great number at the depth of about thirty feet from the top. I was informed that the fossil remains of the mammoth (a name commonly applied in the United States to the mastodon) had been obtained, together with the bones of some other extinct mammalia, from below these shells in the undermined cliff. The bones were stained or black, and were in the same condition as the fossil bones of other mammals with which they were found." Nevertheless, Lyell was then of opinion that the bone might have been dislodged from some old Indian grave near the top. Now, he observes, such a theory would not be resorted to if the bones belonged to any other animal, but as this discovery of a human pelvis was the first he ever heard of, he ventured an explanation which he at present is not inclined to insist upon.

On reviewing all these discoveries, we are forced to admit that the facts are few in number, though they furnish us with some starting points, which deserve our attention. We are entitled to assume that the cave population, in which the carnivora predominate, was contemporary with the elephant and the rhinoceros, whose remains are chiefly found in the stratified alluvial formation. The appearance of both may have been simultaneous, though they may have become extinct at different epochs. We must take into particular consideration, that just from the appearance of the cave-bears and the mammoth dates an uninterrupted chain of phenomena reaching down to the present period: that at different periods species became extinct or were exterminated by man, whilst, perhaps, some new species, though few in number, were developed. It is, therefore, not surprising, that if man appeared on the scene simultaneously with the cave-bear and the mammoth, some species of mankind should also have become extinct, whilst others

were preserved, propagated, and further developed. I shall, in the next lecture, have to treat of the relation of man to surrounding nature, as well as of the development of the so-called diluvial period and its sub-epochs. This lecture I shall conclude with some observations on the condition of primitive peoples, and the relation of their race to existing races.

As regards the primitive culture of man, it was manifestly confined within very narrow limits. The Belgian and Westphalian caves, the sepulchre in Aurignac, the alluvial formations can alone give some clue. No other implements of that period have come to hand, except some rude stone weapons bearing as yet no trace of any polish. Though these have only been found in spots where they were originally fabricated, still it is somewhat striking that of that period none of better workmanship are found, none of them have a handle of staghorn or bone, as seen in tools belonging to a later period. Even the bear-jaws fashioned into weapons show no trace of polish, as seen in those of a more recent period. The pieces are simply struck off as if with a sharp stone.

With respect to aliment, we have no trace of any other than animal food. Nowhere do we find any traces of vegetable food, not even hooks or nets for the capture of fish. Man attacked his prey like the wild animals, by cunning, speed, or strength, so that with his simple stone weapons he even mastered the young rhinoceros. Man provided his dress from the skins of animals, which he sewed together with sinews by means of needle-shaped bones. His dwelling was probably a nest or a hut, constructed of boughs, perhaps, but little better than those constructed by the anthropomorphous apes. This primitive man possessed no domestic animals, and nowhere is there any trace found of them. The dog seems to have been the first animal which, at a later period, became attached to man.

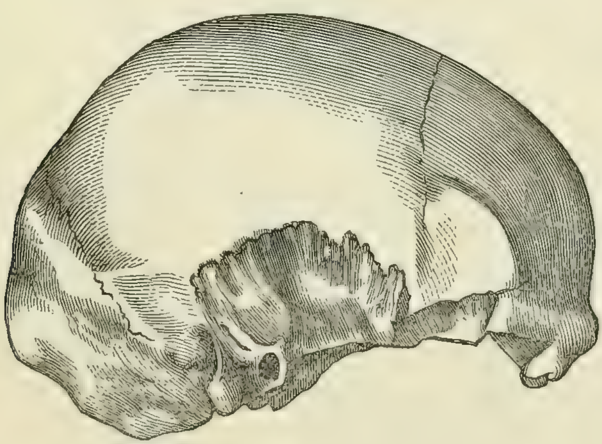
This is the paradisiacal state of the primitive man, so far as it is known to us, as narrated by those silent witnesses, the stones and bones. From such a low condition, compared to which that of the so-called savages of the old and new world is a refined civilisation, has the human species gradually ex-

tricated itself, in a bitter struggle for existence, which it was well able to maintain, by being gifted with a larger amount of brain and intelligence than that possessed by the surrounding animal world.

But even this amount of intelligence was comparatively but a moderate one, as shown by the crania dating from that period. We possess but two imperfect specimens of this kind —the skull of the Neanderthal and that of Engis, which we shall now examine.

The skull of Engis, of which, thanks to Dr. Schmerling of Liège, Geneva possesses a fine cast, is more perfect than the Neander skull; for on the right side, besides the frontal bone and the parietal bone, the greater part of the occipital and mastoid process, with the *meatus auditorius,* are well preserved; whilst of the Neander skull we only possess the roof

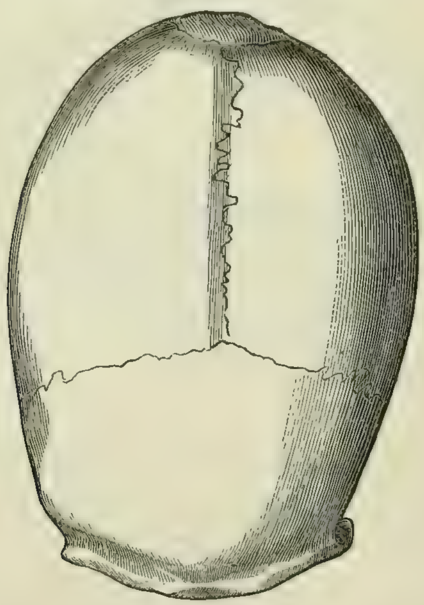
Fig. 94. Engis Skull in Profile.



of the cranium, the facial bones being entirely absent, and the base of the skull destroyed. This, no doubt, is very unfortunate, as regards the proper estimation of the skull. Thus it is impossible positively to determine whether the skull was prognathous or orthognathous, though the presumption is that it was prognathous. As little can the form of the face be determined, still less the formation of the angles at the base of the skull. We must, then, rest satisfied with what we possess, and draw our deductions accordingly.

The Engis skull is of medium size and belonged to an aged subject, for the sutures are here and there obliterated, the coronal suture especially. Possibly the skull is that of a female, as the bones are thin in comparison with those of the Neander skull. Viewed from above, the skull presents a longish oval form; its greatest width is in the posterior third; the apex, somewhat obtuse and rounded, is in the forehead. It is decidedly a long head, for the greatest length to the greatest width is as 100 to 70·1, a proportion which, according to Welcker's table, approaches nearest the Esquimaux skull, and is scarcely different from that of the Negro and Austral-Negro. This length and narrowness of the skull, with the small elevation of the forehead and the form of the orbits so widely apart, induced Schmerling to characterise it as an Ethiopian skull, which at that time was the more excusable as but little attention had yet been paid to the Australian

Fig. 95. Top view of Engis Skull.



race. The Engis skull, however, is at once easily distinguished from that of the genuine Negro by its slight curvature behind the orbits, where the Negro head seems compressed; consequently, too, by the lesser depth of the temporal

fossæ and by the form of the occipital part of the skull, which in the Negro is more globular. Viewed from above, well characterised Negro heads appear more simious than the Engis skull.

"The front view," says Huxley, "shows that the roof of the skull was very elegantly and regularly arched, and that the greatest transverse diameter was a little less below the parietal protuberances, than above them. The forehead cannot be called narrow in relation to the rest of the skull, nor can it be called a retreating forehead. On the contrary, the antero-posterior contour of the skull is well arched, so that the distance along that contour, from the nasal depression to the occipital protuberance, measures about 13·75 inches. The transverse arc of the skull, measured from one auditory foramen to the other, across the middle of the sagittal suture, is about thirteen inches. The sagittal suture itself is 5·5 inches long.

"The supraciliary prominences or brow-bridges are well, but not excessively, developed, and are separated by a median depression. Their principal elevation is disposed so obliquely, that I judge them to be due to large frontal sinuses.

"If a line be drawn, joining the glabella with the occipital protuberance, no part of the occipital region projects more than one-tenth of an inch behind the posterior extremity of that line, and the upper edge of the auditory foramen is almost in contact with a line drawn parallel with this upon the outer surface of the skull. A transverse line drawn from one auditory foramen to the other, traverses, as usual, the fore part of the occipital foramen. The capacity of the interior of this fragmentary skull has not yet been ascertained."

Thus far Huxley; to whose description I would add, that assuming the line from the occipital protuberance to the glabella to be horizontal, the cranium is so arched that its greatest height would fall behind a perpendicular drawn upon it, through the *meatus auditorius*, and that the slight vaulting of the occiput, as well as low position of its protuberance, give it a significant character. Though not a very striking occurrence in civilised skulls, it is so in the skull of a savage, to find the muscular lines and ridges so little developed, especially when

we compare them with those of the Neander skull. As to the rest I agree with Professor Huxley, who says:—"I confess that I can find in the remains of the Engis skull no character, which, if it were a recent skull, would give any trustworthy clue to the race to which it might appertain. Its contours and measurements agree very well with those of some Australian skulls which I have examined; and especially has it a tendency towards that occipital flattening, to the great extent of which, in some Australian skulls, I have alluded. But all Australian skulls do not present this flattening, and the supraciliary ridge of the Engis skull is quite unlike that of the typical Australian.

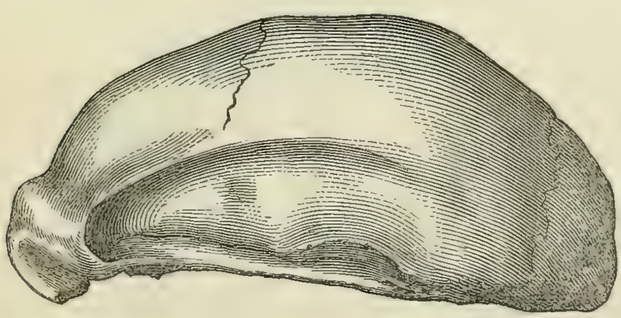
"On the other hand, its measurements agree equally well with those of some European skulls." (According to Welcker's table, there is not one European skull which, as regards the proportion of length to breadth, can be compared with the Engis skull.) "And assuredly there is no mark of degradation about any part of its structure. It is, in fact, a fair average human skull, which might have belonged to a philosopher, or might have contained the thoughtless brain of a savage."

From the materials at my command, I cannot altogether agree with these last remarks of Huxley. The exceptional length and narrowness of the cranium, with its slight elevation, conditions a proportionately small internal capacity. It is the projection of the approximated frontal eminences which makes the forehead appear arched. But from these frontal protuberances the arched line to the vertex is rather flat, and consequently the anterior lobes of the brain but little developed. These proportions, however, concern only the individual development of the cerebral mass. The essential character for determining the race lies in the proportion of the length to the breadth, and in this respect the Engis skull is one of the most ill-favoured, beast-like, and simious skulls we know of. In Welcker's list there are, no doubt, some very few (probably belonging to females) exceptionally long skulls of Europeans, which approach or even exceed the length of the Engis skull, namely, one French, one Dutch, and two Finnish skulls. But

these skulls differ so widely from those of their cognates, that they can only be considered as abnormal exceptions. Still it is somewhat striking that the Dutch skulls are, on the whole, longer than those of all other Europeans, and specially of the Germanic peoples, an indication, perhaps, of the commixture of the oldest race with its typical cranial form with the peoples now inhabiting these parts.

In my opinion, which is, certainly, not founded on numerous investigations, this Engis skull holds an intermediate place between that of the Australian and the Esquimaux. Of the latter, it possesses the comparatively thin bones, the scantily developed brows, the height of the profile in the posterior part, and the proportion of the diameters. Of the first, it has the oval form of the cranium, the rounding of the parietal line, the flat forehead, and the outline of the roof of the cranium. I know of no living cranial form which perfectly agrees with that of the Engis skull, but I have in some Swiss crania (of the fourth and fifth century) near Biel, Grenchen, and Solothurn, seen forms much resembling the Engis skull even in the chief measurements.

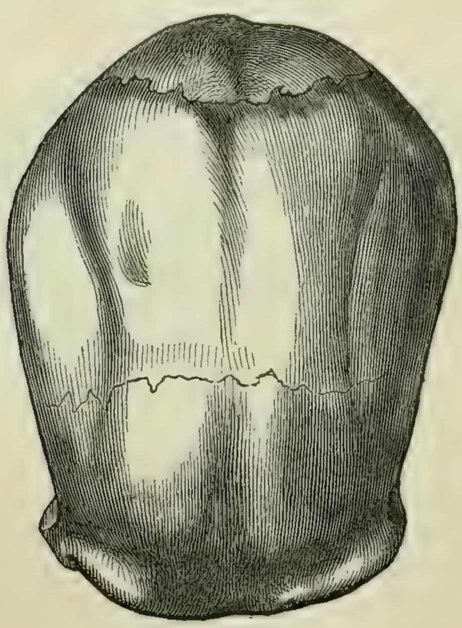
Fig. 96. The Neander Skull in Profile, after a plaster cast.



The Neander skull, of which the Geneva museum, thanks to Prof. Fuhlrott, possesses a cast, differs in many respects from the Engis skull, though it resembles it in some. I shall give the description in the words of Prof. Schaaffhausen, who first anatomically examined it. "The cranium is of unusual size, and of a long elliptical form. A remarkable peculiarity strikes us

at once in the extraordinary development of the frontal sinuses, by which the supraciliary ridges coalescing in the middle become so prominent, that above, or rather behind them, the frontal bone presents a considerable depression, whilst a hollow is also formed in the region of the root of the nose. The forehead is narrow and flat, but the middle and posterior portions of the cranial arch are well developed. The semicircular line, indicating the upper attachment of the temporal muscle, though not strongly developed, ascends to more than half the height of the parietal line. On the right orbital ridge, is observed an oblique furrow indicative of some injury received during life; upon the right parietal bone is a depression of the size of a pea. The coronal and sagittal sutures are on the exterior nearly, and on the inside of the skull entirely effaced. The lambdoidal is open; the frontal is indicated externally by a slight ridge, and where it joins the coronal, this ridge also becomes slightly protuberant. The sagittal sature is grooved, and above the angle of the occipital bone; the parietal bones are depressed.

Fig. 97. Neander Skull, top view.



"There is no valid reason for considering the enormous development of the frontal sinuses in the remarkable Neander skull as an individual or pathological abnormity; it is unmistakably a racial type, and stands in physiological connexion with the striking thickness of the bones of the skeleton, exceeding by one-third their usual strength. This expansion of the frontal sinuses, which are appendages to the respiratory organs, indicates both strength and endurance in muscular activity, as shown also by the development of all the ridges and processes to which the muscles are attached. That large frontal sinuses have this signification is confirmed by other observations. Pallas distinguishes by this mark the wild from the tamed horse. According to Cuvier, it distinguishes the fossil cave bear from the living species; according to Roulin, the wild boar from the domesticated hog, the chamois from the goat, and, finally, the bony and muscular bulldog from all other species of dogs. To determine the facial angle, which, according to Owen, is in the large apes rendered difficult by the projecting orbits, is in our skull rendered more so by the absence of the nasal spine and the auditory meatus. But if the horizontal plane be taken from the remaining portions of the orbital plates, and the ascending line is made to touch the surface of the frontal bone, behind the prominence of the supraciliary ridges, the facial angle amounts to no more than 56°. Unfortunately, no portion of the facial bones, so important for determining the form and expression of the head, has been preserved. The cranial capacity, compared with the great strength of the corporeal structure, apparently indicates a small cerebral development. The skull holds nearly thirty-one ounces of millet seed, and as from the proportion of the wanting bones six more ounces should be added, the contents of the whole cranial cavity might be taken as thirty-seven ounces.

"Tiedemann estimates the cranial capacity of Negros at forty, thirty-eight, and thirty-five ounces of millet seed. The cranium holds rather more than thirty-six ounces of water, which corresponds to a capacity of 1,033·24 cubic centimeters. Huschke estimates the cranial capacity of a Negress at 1,127 cubic centimeters; that of an old Negro at 1,146 cubic centimeters.

The capacity of Malay skulls, measured with water, equalled thirty-six to thirty-three ounces; whilst in the diminutive Hindoos it diminishes to twenty-seven ounces.

"Under whatever aspect," says Huxley, "we view this cranium, whether we regard its vertical depression, the enormous thickness of its supraciliary ridges, its sloping occiput, or its long and straight squamosal suture, we meet with ape-like characters, stamping it as the most pithecoid of human crania yet discovered. But Professor Schaaffhausen states that the cranium in its present condition holds 1,033·24 cubic centimeters of water, or about sixty-three cubic inches; and as the entire skull could hardly have held less than an additional twelve cubic inches, its capacity may be estimated as at about seventy-five cubic inches, which is the average capacity given by Morton for Polynesian and Hottentot skulls."

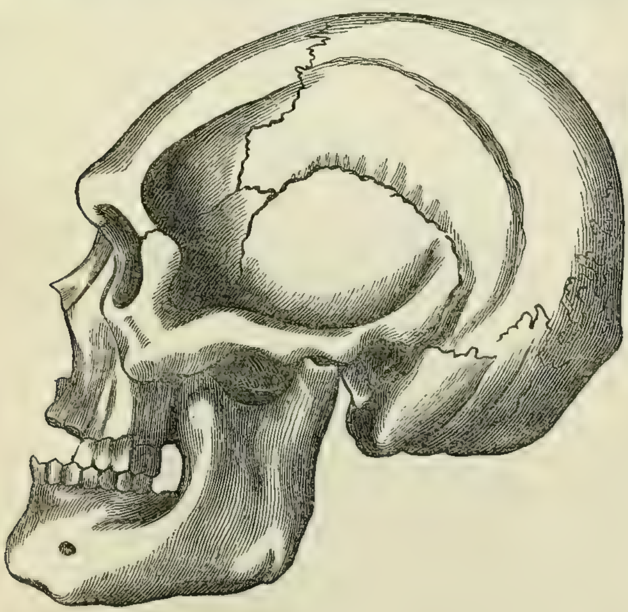
"So large a mass of brain as this would alone suggest that the pithecoid tendencies, indicated by this skull, did not extend deep into the organisation; and this conclusion is borne out by the dimensions of the other bones of the skeleton given by Professor Schaaffhausen, which show that the absolute height and relative proportions of the limbs were quite those of an European of middle stature. The bones were, indeed, stouter, but this and the great development of the muscular ridges noted by Dr. Schaaffhausen are characters to be expected in savages. The Patagonians, exposed without shelter or protection to a climate possibly not very dissimilar from that of Europe at the time during which the Neanderthal man lived, are remarkable for the stoutness of their limb bones.

"In no sense, then, can the Neanderthal bones be regarded as the remains of a human being, intermediate between man and apes. At most they demonstrate the existence of a man whose skull may be said to revert somewhat towards the pithecoid type—just as a carrier, or a pouter, or a tumbler, may sometimes don the plumage of its primitive stock, the *columba livia*. And, indeed, though truly the most pithecoid of known human skulls, the Neanderthal cranium, is by no means so isolated as it appears to be at first, but forms in reality the extreme term of a series leading gradually from it

to the highest and best developed of human crania; on the one hand, it is closely approached by the flattened Australian skulls of which I have spoken, from which other Australian forms lead as gradually to skulls having very much the type of the Engis skull; and, on the other hand, it is even more closely affixed to the skulls of a certain ancient people who inhabited Denmark during the stone period, and were probably either contemporaneous with or later than the makers of the 'refuse heaps', 'Kjökkenmöddings' of that country.

"The correspondence between the longitudinal contour of the Neanderthal skull, and that of some of the skulls from the tumuli at Borreby, very accurate drawings of which have been made by Mr. Busk, is very close. The occiput is quite as retreating, the supraciliary ridges are nearly as prominent, and the skull is as low. Furthermore, the Borreby skull resembles the Neanderthal form more closely than any of the Australian

Fig. 98. Skull from a Tumulus at Borreby: Danish Stone Period.



skulls do, by the much more rapid retrocession of the forehead. On the other hand, the Borreby skulls are all somewhat broader, in proportion to their length, than the Neander-

thal skull, while some attain that proportion of breadth to length (80 : 100) which constitutes brachycephaly."

Fully agreeing with these observations, I will only add some few remarks. The least developed skull of Borreby (see fig. 98) stands far above the Neander skull by the arched elevation of the middle head, but differs from it entirely by the form of the occiput and the great breadth of the skull, which renders it decidedly brachycephalous. The only distant similarity between these two types consists in the flattening of the forehead and the projection of the eyebrows. Apart from size, the forehead of the Neander skull is that of an idiot or microcephalus. Up to the occiput, which presents different proportions, the profile of the idiot, which Owen delineated for comparison with the chimpanzee (see fig. 47, p. 145), corresponds with that of the Neander skull. As surely as a man of the white race with a brain like that of the Hottentot Venus, justly remarks Gratiolet, would be an idiot, so surely would a white man with a Neander skull be an idiot in the midst of his more gifted race.

But apart from the height of the skull, the development of the forehead and eyebrows, I still find a great similarity between the Engis and the Neander skulls, which becomes striking when viewing them from above. The Engis skull is somewhat narrower; its length in proportion to its breadth being 10 : 7, which in the Neander skull is 100 : 72; but in other respects we have the same lines, the same general form. Taking now into consideration that the female skull is on the average smaller than the male; that it is narrower and longer; that its roof considerably predominates over the base; that its bones are thinner, and that the muscular attachments as well as the eyebrows are always less developed; and considering further their simultaneous appearance in the same region, and the oscillations which the Austral-Negros also show in the development of the eyebrows, the forehead, and the height of the skull, I arrive at the rather hazardous conclusion that both skulls belong to one and the same race, and that the Neander skull belonged to a muscular but stupid male, while the Engis skull, perhaps, belonged to an intelligent woman.

The examination of the cast taken from the internal surface of the Neander skull, kindly sent me by Professor Fuhlrott, fully confirms the opinion derived from the inspection of the bones. As already stated, some at least of the principal convolutions of the cerebral surface, as well as the vessels and the so-called Pacchionian glands, leave impressions upon the inner surface of the skull and admit of some comparisons.

On comparing the side-view with that of the external surface, reduced to the same scale, namely, fig. 94, or the top view with fig. 95, we are immediately struck by the difference in size, which is mainly the result of the great thickness of the cranial bones. Professor Schaaffhausen, of Bonn, who compared this cast with that of an Austral-negro, has the

Fig. 99. Cast of the cerebral surface of the Neander Skull, side view.

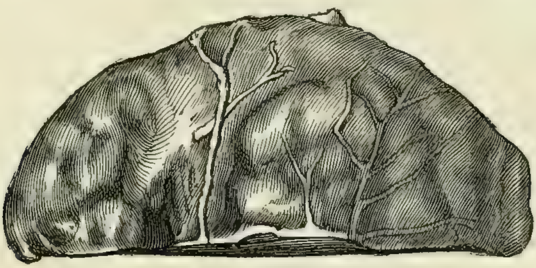
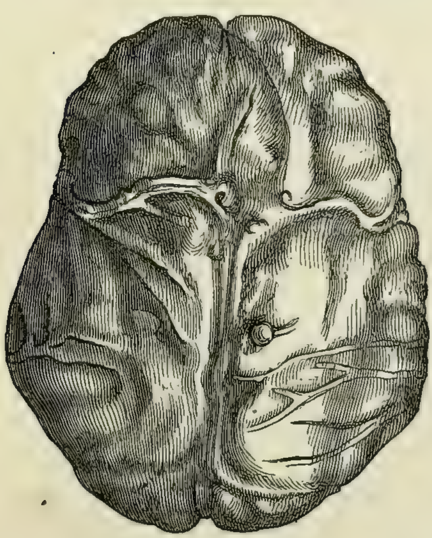


Fig. 100. Same cast viewed from above.



following observations in the *Transactions* of the Natural History Society of the Lower Rhine. "This cast shows the greatest similarity, as regards cerebral development, to that of an Australian, placed by the side of it. The proportions in the former are, as regards size, rather more favourable than in the latter. But the difference in the cranial shape is also exhibited in the form of the brain. The length of the hemispheres of the Neander skull amounted to 173, the width of the anterior lobes to 112; the greatest width of the brain 136, the greatest height of the brain above a line connecting the extreme points of the anterior and posterior lobes, 67 millimeters. These extreme measures are in the brain of the Austral-negro : 164; 100; 125; 77. Lucae found, that although the brain of Europeans is on the average 300 grammes heavier than that of the Australian, that of the former is neither in length nor in height much greater than that of the latter, but exceeds it much in width. It is noteworthy that this difference in race type is traceable in the remotest period, when there were, in our parts of the globe, men who stood in the same intellectual scale as the living Australian savage."

I have had a cast taken of the cranium of a Swiss skull in the Museum of Bern, which I have called an "Apostle skull," and which is at the service of my friends. The greatest length of the hemispheres of this cast is 180; width of the anterior lobes 110; greatest width of brain 127; greatest height, which, on account of the greatly developed Pacchionian glands, cannot be exactly ascertained, about 63 millimeters. On reducing these numbers, on the assumption of the greatest length=100, we obtain the following comparable proportions:—

Cast.	Length.	Width of anterior lobes.	Greatest width.	Height.
Neander skull	100	64·7	78·6	38·9
Australian	100	60·9	76·2	46
Apostle	100	61·1	70·5	35

I know not whether these measures can be really considered as measures of the cerebral development—for if this be the case, the Neander skull would in every respect stand above those of the Australian and the Apostle skull; whilst, accord-

ing to the general form, the reverse is the case, at least as regards the relation of the Neander skull to the Apostle skull.

On viewing the Neander cast from the side, the frontal lobe seems remarkably small and separated from the vertical convolutions by a deep depression, across which the large blood-vessel of the cerebral membrane ascends nearly perpendicularly. At the same time, the imprints of the convolutions are comparatively broad and coarse—like those in the Hottentot Venus, whilst these very convolutions, which are indicative of the convoluted state of the whole brain, are more numerous and more curved in the Apostle skull, nay, were on the surface of the frontal lobe so fine, that they left only an undulating mark. We observe the same condition in the lower parietal temporal lobe, where at least two floors are as plainly indicated as in the Orang and the Hottentot Venus.

Not less remarkable is the break in the posterior lobe provided with some few coarse convolutions—a break which is so considerable, that we might be induced to believe that the transverse occipital fissure is developed in the same manner as in the ape. This break is also seen when viewed from above. Over the apex of the right occipital lobe the lateral venous sinus winds up to the vertical, as Schaaffhausen justly contends, against Huxley's opinion. The characters of cerebral development, still recognisable, thus indicate a very degraded human race, approaching the simian type.

But whom did this primitive race of Europe resemble most? —the Australian, the most disgusting type of living savages! Poor Adam! Poor Eve!*

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* The author's sarcasm on this occasion is not based on any well ascertained fact. There is no character in the Neanderthal skull to show that it belonged to the Australian or any other race. Much less is there any reason to suppose that this skull represents the primitive race of Europe: without wishing to dispute in the least that it may be of a very high antiquity. With respect to the race-characters of the Neander calvarium, Dr. J. Barnard Davis, a most competent and painstaking observer, has just given his opinion in these emphatic words:—"The peculiar form of this Neanderthal example, I am satisfied, is the result of a synostosis, and is not in any way to be regarded as a race-character." See *Memoirs read before the Anthropological Society of London*, vol. i, 1864: Trübner and Co.—EDITOR.

LECTURE XI.

The Diluvial Period.—Revolutions and Transitions.—Glacial formation.—Boulder-Clay.—Old Alluvium.—Terminal Moraines and Erratic Blocks.—Slate-Coal, and its Formation.—Ice-sea and Glacial Formation in the North—In England.—Table of Diluvial Strata.—Length of Time.—Chronological Calculations in the Deltas of the Mississippi and the Nile.—Impossibility of a Universal Deluge.

Gentlemen,—Our investigations concerning man's appearance upon the globe have, indeed, furnished us with a clue as to the geological period in which that event occurred, but leave us in the dark as to the determination of the year or century. With regard to the geological period, we may state at once that it is the last period we treat of, since which there has apparently been no interruption down to the present time. We possess, at present, no facts for determining the age of human fossils calculated by centuries or millenniums. All that we are entitled to say is, that these remains are very old, reaching far beyond the time assigned by current traditions and legends concerning man and the creation of the earth. When treating of more recent remains we shall have an opportunity of mentioning the attempts which have been made chronologically to determine the age of some relics from the overlying strata in which they were found. For the present, we shall consider the geological period in which man first appeared.

I must begin with a confession. There was a time when the history of the earth was construed from individual, independent periods, separated from each other by mighty revolutions. It was assumed that, during the intervening periods of rest, a new creation arose, propagating and accumulating until the crust of the earth suddenly bursting, chains of mountains were formed, vast regions became submerged, and sea-covered tracts laid bare. After every revolution, which des-

troyed every living being, a new creation took place with more perfect forms, according to a premeditated plan by the interference of a personal creator. I confess that the simplicity, clearness, and, so to speak, mathematical precision with which this theory was propounded by the highest authorities greatly captivated me in my younger years—excepting, perhaps, the idea of the interference of a personal creator, which I found at all times difficult to reconcile with the laws of sound reasoning. If this creator, as Rolle alleges, is the keystone of the whole system, my disbelief in his interference has probably contributed to my speedy rejection of the whole theory. A continued examination of these questions from every point of view, and a thorough investigation of the facts upon which any part of the theory rests, led me and the majority of my contemporaries to the conviction that there were no such independent periods in the history of the earth, but only a gradual development. Here and there, temporary and local convulsions may have occurred, but these were confined to comparatively small regions of the surface of the earth, and nowise extending their destructive effects over the whole globe. The various species of living beings, plants, and animals, did not become extinct at once, like fire at the approach of the Föhn (a moist south wind on the lakes of Switzerland), and rekindled after its passage. Species are constantly disappearing from the list of living beings; but new ones arise, and the aspect of the remains of extinct life in the strata changes as gradually as that of the species at the present time. Instead of sudden revolutions, I, on the contrary, merely behold infinitely long periods of time, during which the effects of apparently small forces, acting in the smallest visible proportions, gradually accumulate until, suddenly as it were, they reveal their might. It would lead us too far to enter upon this subject more fully; but I felt bound to touch upon it, to prevent misapprehension of what follows.

The end of the tertiary period, which we do not separate from the present by a sharply defined line, but by a broad transitional margin, was, doubtless, distinguished by a somewhat warmer climate, from that which at present obtains in central Europe, and which is, by the way, rather exceptional when com-

pared with other regions of the earth. Whilst in the middle of the tertiary period, palms were growing in Switzerland, and high Californian pine trees in Iceland, the end of the tertiary period was marked by a number of evergreen plants, with a temperature in Switzerland like that of Italy; on the shores of the Mediterranean neither plants nor animals show the evidence of any conditions which might have been detrimental to the life of man in the tertiary period. Just as at present, man can live in the same climate as the ape, the hippopotamus, the elephant, and the rhinoceros, so could he have existed side by side with these animals and their corresponding Flora in the tertiary period. That human fossils may, at some future time, be found in the tertiary strata, is rendered probable by the discoveries of M. Desnoyers, member of the French Academy, who found traces of the existence of man in strata older than the quaternary deposits. These consist in striæ, or incisions, some very fine, which were apperently produced by the aid of flint knives, upon the bones of large animals, found in a sand-bed of St. Prest, near Chartres, on the banks of the Eure.

"The sand-beds of Saint-Prest," says Laugel, in his description of the departments of Eure et Loire, in 1860—that is to say, at a time when the dispute about the relative age of the diluvial beds had not yet commenced, and consequently there was no motive for ascribing to these strata a greater or less antiquity—"the sand-beds of Saint-Prest have nothing whatever to do with the diluvial deposits proper, which, on their part, are connected with the excavation of the valleys. They fill up a lateral depression which must have existed before the excavation of the Eure valley. The section of the sand-pit presents, beneath a thick layer of surface clay first, banks of gravel, then beds of white sand containing pebbles, and at the bottom beds of very fine white sand. In the whole sand-pit, excepting these lower fine sand-beds, there are found large worn-down blocks of flint, sand-stone, sometimes a siliceous conglomerate; some veins in the lower parts contain also portions of felspar, mixed with transparent quartz."

The sand-pit of Saint-Prest contains, in the lowest part, imbedded in the fine sand, a large number of the bones of

extinct animals; among others a species of elephant, rhinoceros, hippopotamus, large stag, horse, ox, three species of deer, and a large rodent, which seems to have held an intermediate position between the beaver and the *paca;* the remains of species of pachydermata: *Elephas meridionalis, Rhinoceros leptorhinus* and *Hippopotamus major,* agree perfectly with the species found in the vicinity of Asti, in the Arno valley, and in the so-called Norwich-crag; strata which undoubtedly lie beneath the diluvial beds proper, and have hitherto been considered as belonging to the most recent tertiary formations.

These three species differ entirely from the mammoth *(Elephas primigenius)*; the rhinoceros *(Rhinoceros tichorhinus)*; and the diluvial hippopotamus; just as the *Megaceros Carnutorum* differs from the *Megaceros Hibernicus,* and the horse from the diluvial horse, belonging probably to that species from the Arno valley,* which is known by the name of *Equus plicidens.* Lyell, in his work which appeared in 1863, still asserts that the *Elephas meridionalis* had not yet been found associated with man.

Now if it could be proved that the bones in the deposits of Saint-Prest bear indeed the traces of the human hand, which markings must have been made before the deposition of these bones in these old sand-beds, then the age of mankind is necessarily removed beyond the diluvial epoch, and further back into the tertiary period. An unprejudiced person will not feel surprised at this; there are no sufficient reasons against the assumption that man may have lived in the tertiary period in countries inhabited by elephants, rhinoceros, oxen, horses, and apes.

Desnoyers found, on some bones which he extracted from the sand-pit, and subsequently upon all the bones preserved in collections, traces of incisions, consisting mostly of transverse, straight, curved, or elliptical striæ. Upon the cranium of an elephant he found a triangular cavity, apparently produced by the point and barb of a flint arrow. The skulls of the large deer seem all to have been broken by a blow upon the frontal bone at the root of the horns. The antlers are broken in pieces

* And common in English deposits.—EDITOR.

to serve as handles, some were longitudinally split for the sako of the marrow. Similar characters have been observed in the kitchen-middens, as well as in the bones of the Swiss pile works.

Desnoyers's discovery was confirmed by leading men in science. It is true that MM. Robert and Bayle objected (evidently to save the theory of Beaumont) that the scratches on the bones in the collection of the *Ecole des Mines* of Paris had been made by the preparer of the specimens, who scratched off the adhering sand with a chisel. Desnoyers found, however, no difficulty in proving that the objection was puerile, for four reasons: because the bones not in the *Ecole des Mines* have all the same striæ; because the bones taken directly from the sand-pit also have them; because in these notches there are sandgrains, and therefore the bones must have been thus marked before they were imbedded; and, finally, because the said white sand adheres so little to the bones, that no chisel, but only a little water, is required to cleanse the bones.

As, however, Desnoyers's discoveries must as yet be considered as isolated, we are still justified in asserting that, generally speaking, man has only appeared in Europe and North America during the so-called diluvial, post-pliocene, or quaternary period.

There is ample evidence, that this last period was accompanied with a considerable refrigeration of our hemisphere, which increased so much that at a certain period the whole of Switzerland, the Scottish Highlands, Scandinavia, and a portion of North America were covered with ice. The question now arises: Did man exist in France, Belgium, and England before or after this glacial period? The question is so far interesting, that in case of man's pre-existence the glacial period may have put a stop to his existence in the aforesaid regions. But let us examine the geological conditions apart from man.

Everywhere in Scandinavia, North America, and England, as well as in the vicinity of the Alps, we meet with a formation which is generally called glacial-loam or boulder-clay. This formation, of marl or plastic clay, which in all countries is used in brickmaking, is spread over the surfaces in layers of varying

thickness. It overlies the platforms, follows the slopes of mountains down to the valleys, it forms frequently the bottom which prevents rivers from further excavating the valleys; it contains in the North large angular erratic blocks, or rounded, scratched, and striated rolled stones in the vicinity of the Alps and the Scandinavian mountains. Where the formation reposes upon solid rocks, the latter are polished, grooved, and striped like the rocks passed over by a glacier. Most geologists of the present day agree as to the origin of this formation. It is the glacial loam produced by the grinding of the rock under the weight of the moving ice masses, which also produced the scored stones. Where these latter only exist, it is the lower moraine which so presents itself; but where large blocks occur, then either the earth-moraine has coalesced with the fundamental moraine, or the angular blocks have been carried upon the moving ice masses and deposited in the loam.

On taking, for the present, this formation as a starting point, we find that but few land and fresh-water deposits are known which intervene between this formation and the tertiary period. That the tertiary period did not suddenly enter the glacial epoch, seems to be proved by the condition of those tertiary strata known in England as "crag." There was also found, near Cromer, on the Norfolk coast, a group of beds underlying the glacial loam, but characteristically distinct from the tertiary period. There are sunken forests which, in many spots, are exposed at low water. The roots of the broken off trunks are still in their natural position, and the loam in which they are imbedded is black from the intermixture with vegetable matter. The fir, pine, yew, alder, oak, and sloe grew here in a marshy soil, in which the white, and yellow water lilies, marsh-trefoil, frogsbit, and other aquatic plants of our present Flora, were found. There were also discovered fossil bones of three species of elephants, of the mammoth, rhinoceros, hippopotamus, of the extinct large beaver, of horses, oxen, deer, the common beaver, and the water rat, of the walrus, the narwhal, large whales whose carcasses had been washed ashore.

This fresh-water formation, the insects and shells of which

belong to living species, must therefore be separated from other diluvial formations, in so far as it contains along with extinct, many of the existing species, and the plants, at all events, are of the same kind as are found in the later deposits above the glacial loam. The spread of the glaciers, therefore, does not, as hitherto believed, mark a new epoch, a new section in the history of the earth; it only changed temporarily the aspect of the earth, of the Fauna and Flora, where it occurred. After the retirement of the glaciers and the Arctic sea to its present northern confines, the antecedent condition was re-established; the Fauna and Flora returned to their native district, excepting some species which became extinct. We are, however, far from asserting that no new species arose after the retirement of the glaciers. Desor has with great acumen shown the fallacy of such an assumption, and if we accept the theory of the transformation of species, there is no reason why this metamorphosis should not proceed as well in the present as it did in periods gone by.

Let us now examine the various deposits, which have occurred since the glacial period, and let us commence with Switzerland, where the comparison with the process still in action in the Alpine chain gives a clue to the origin of the above phenomena. The glacial loom is, in that country, a more or less grey or bluish clay, without any trace of stratification, and in which, near the Alps and almost on the whole plains of Switzerland, are found polished and furrowed stone boulders. This formation is obviously connected with the large angular erratic blocks on the slopes of the Jura, which, on the Chasseron, in Waadtand, rise to 1,600 meters above the level of the sea, or 1,000 meters above that of the lakes. It is now generally admitted that these blocks have been deposited by the glaciers, which have spread over almost the whole plain of Switzerland, and Swiss geologists have succeeded in nearly determining the limits of these old glaciers which reached far up the Jura. I must refer you to the map of Escher von der Linth, which you will find in my text-book as well as in my *Principles of Geology*, and in which the limits, which these glaciers reached at the time of their greatest expansion, are marked.

Morlot, with whose deductions, as regards two glacial epochs, I do not agree, has, nevertheless, very clearly shewn the connection between the blocks and the glacial clay. Such enormous masses of ice must, by their under surfaces, produce a corresponding quantity of till, hence the glacial clay is found in immense quantities near the Alps, for instance, near the lake of Geneva, where it is forty feet deep. It is also clear, that at a time when the ice masses reached the highest cliffs of the Jura, no angular blocks could have been deposited upon the level land, and that the lower blocks on the Jura must belong to the period of recession, during which the formation of the glacial clay continued as long as the motion of the glaciers upon the soil. But it is not less clear, that at the time of this greatest extension, but few Alpine pinnacles rose above the Swiss ice-sea; that, consequently, but comparatively few blocks could be transported upon the ice, and therefore no perfect moraines could be formed, as is the case with smaller glaciers which receive the detritus from more extensive rocky tracts.

Upon this glacial clay in Western Switzerland we find, in many places, considerable beds of pebbles, gravel, and sand, which are, by the infiltrated lime, so cemented together as to form a species of gompholith. The pebbles frequently attain the size of a man's head, or even larger. They show no traces of grooves or striæ, but are simply rounded and clean; nowhere is clay or marl attached to them; they are manifestly rounded by the action of water. One of the finest specimens of such deposits may be seen near Geneva, where the heights of St. Jean and the woods of Lancy, through which the bed of the Rhone runs, consist of such old alluvia, which are also found in great extent in most other parts of Switzerland. Of particular deposits of this kind in Eastern Switzerland I shall speak on another occasion.

It is clear that these old alluvia could only have been deposited after the retreat of the glaciers towards the Alps. As the retreat of a glacier is effected by the melting of its mass, which necessarily produces an accumulation of water, it is evident that the recession of colossal glaciers gave rise to turbulent streams, which here and there excavated their beds, but

in other places formed temporary lakes. This retreat of the glaciers was manifestly a very complicated phenomenon, as the main features of the formation of the soil, as they exist at present, were already extant (by which assertion we deny what has recently been asserted, namely, that the glaciers at the period of their greatest extent scooped out, in the soft molasse soil, valleys and lake basins). The glaciers remained longer in the valleys and the basins, and sent forth branches between the molasse hills already free from ice. It must further be taken into consideration that such a retreat was never uniform. The alternation of colder or warmer years, and consequent variations of the limits of glaciers and of their elevation are common phenomena, and the history of our Alps speaks of meadows and fields, alternately covered with or free from glaciers. Many accurate local investigations are requisite before we shall possess a full account of the retreat of the glaciers in Switzerland, though we have a general notion of its main features.

The retreat of the glaciers is evident at some distance from the Alps, in the great valleys and lake basins, where the ice continued as such for a longer period. In the immediate vicinity of the lakes of Geneva, Sempach, Zürich, Hallwyl, Greifen, and Pfäffikon, in the valleys of the Aar near Berne, of the Reuss near Bremgarten, of the Limmath near Baden, may be seen terminal morains, which testify to the preservation of the glaciers in the lake basins and deeper valleys.

Morlot very justly observes, that this persistence of the ice must have continued for a considerable time, as some of these moraines are of immense size. But this preservation must have been attended with same phenomena which accompany the retreat of glaciers. Glaciers which stretch forth their icy tongues through the basin of the lake of Geneva, up to Geneva and Nyon, which penetrated the Reuss valley up to Mellingen, the Limmath valley up to Baden, and probably filled up the basin of the lake of Constance, must necessarily have produced larger masses of water than the present dwarfs, which cannot transgress the limits of the inner Alps. The same alluvial formation was deposited in front and on the sides of these

glaciers, and above these formations angular blocks were deposited and pushed forward by the extreme end of the glacier. Escher has shown, that in the whole district of Burgdorf, Wangen, and Langenthal, westward, and eastward over Brugg to Eglisau, there is such an alluvial formation, in which are seen blocks floated by the ice from several basins; but where they were transported by the solid ice, they are less in number. In the vicinity of these ice-tongues, which persisted during the retreat, have been found lake basins produced in the manner described. The waters may at that time, as Morlot assumes, have been one hundred and fifty to one hundred and eighty feet above their present level, and then gradually, when the retreat recommenced, after forming several terraces of about one hundred and then fifty feet above their present height, may have ultimately descended to their present level.

Finally, there commenced a further retreat after the stoppage. Several terminal moraines show that this retreat was not effected without fresh halting places which correspond with the alluvial terraces on the plains, and each of these stoppages may have continued for a long period, for here also we find moraines of remarkable size, which required a long time for their formation. That during this whole period of retrogression, the formation of glacial clay, of alluvia, of rolled pebbles, and the transportation of angular blocks upon floating icebergs, continued uninterruptedly, is undeniable.

I am fully aware that my theory is in antagonism with that of many geologists, who assume two separate ice periods, between which the older alluvia are said to have been deposited. Morlot, Collomb, and many others, especially English authors, defend this dualism, whilst Desor has always insisted upon the unity of the glacial period. Both parties agree as to the facts, but not as regards their explanation. The old alluvium, no doubt, overlies everywhere the old glacial clay with the polished rolled stones, and equally without doubt, above this old alluvium lie angular blocks intermingled with glacier clay and recent alluvium. The stratification of the terminal moraines in the valleys and lake basins of level Switzerland above and upon the old alluvium is however nowhere demonstrated, and

it seems to me that we are justified in assuming, that such blocks as rest upon the old alluvium have not been transported directly by glaciers, but by floating ice blocks. If, indeed, the glaciers had any influence upon the soil, as asserted by some English authors, the influence must have been proportionate to the acting mass. A glacier measuring several thousand feet in thickness, which must be assumed to account for the blocks found on the Jura, must have scooped the soil rather deep, whilst an extremity of a glacier scarcely 100 feet thick, might, for some short distance, pass over a gravelly soil without digging deeply into it. Charpentier, I believe, cites such an instance in Wallis, where, after the stay of the extremity of a glacier for a number of years upon vegetable earth, immediately after the retreat perennials appeared, as if the glacier had exercised no influence upon the soil. But it must be considered that this can only apply to the extremity of a comparatively very small and thin glacier. We may, therefore, assume that in some spots during the retreat, not merely a stoppage but sometimes an advance took place, during which the extremity of a glacier passed a certain distance above the previously deposited old alluvium and also deposited blocks. But we cannot believe that the glaciers spread again in this manner over a great portion of Switzerland, as in this case they would from their weight and size have necessarily scooped out all the older drift and alluvial formations, and destroyed all the loose sand and gravel masses.

In East Switzerland we meet with various phenomena, conditioned by the existence of buried forests and peat bogs. In the vicinity of Utznach and Dürnten, on the lake of Zurich, and near Mörschwyl, on the lake of Constance, there are considerable beds of slate-coal, which manifestly belong to the period we speak of, having originated from the peat bogs, which have been overwhelmed and compressed by enormous masses of drift. This peat bed consists mostly of mosses and reeds, rushes and marsh-trefoil, upon which, at first pines, and then firs and birches, grew. The disposition of these layers is as follows :—

The subsoil of the whole region is formed by molasse, the

beds of which are somewhat vertical. Upon the heads of these beds rests slate clay of considerable thickness with boulders, and large angular blocks, so that this clay manifestly corresponds to the glacial clay. The existence of these large angular erratics, hitherto unnoticed, in the lower clay beds, has recently been clearly demonstrated by Messikomer's examination of pile buildings. Then come coals in horizontal strata nearly twelve feet thick, and upon the coals, drift with clay and rounded blocks, and upon them angular erratics, which, in our opinion, have been floated and not directly deposited by glaciers. The substratum had hitherto not been sufficiently attended to, hence it was believed that the coal beds had been formed before the glacial extension; but Messikomer's researches have shown that the coals overlie the glacial clay, and had therefore been formed immediately after the retreat of the glaciers, after which they were covered with the old alluvium and floated erratics.

On comparing the coal beds of England with those of East Switzerland, they appear at first sight so strikingly identical, that it leads to the belief that they belong to the same period, and were formed simultaneously either before or after the glacial extension. But as such is not the case, and as the two respective formations are, on the contrary, separated from each other by the glacial period, it follows that this glacial extension must have been an intermediate event, which even in countries where it occurred produced no important change. There is no doubt, as we shall presently see, that there have been, specially in the North, great changes produced in the level of various regions. It is probable, that at least before the commencement of the glacial period, if not immediately after it, England and the north of France, Denmark and Norway were connected, whilst, on the other hand, large districts towards the east, now dry land, were under water. With the increase of cold in the north, the northern population retreated southward, an immigration rendered evident by the present composition of the Fauna of the German Ocean and the Baltic. Again, with the cold it retreated, as we have shown, towards the north. Such immigrations and emigrations, like the phy-

sical changes of the surface, and the transposition of clay, gravel, sand, etc., require long periods of time.

Every person who carefully examines the enormous accumulations which the glaciers and the rivers, sprung from them, have deposited upon Swiss soil, must admit that only a long series of centuries, the number of which can scarcely be estimated, could have effected them. This assertion may be proved by the estimation of some individual factors of the beds. We have seen that the coal bed of Dürnten forms but a moderate intermediate stratum in the so-called diluvial beds. This stratum at its greatest thickness, reaches about twelve feet, or rather, ten, for in many places there are intermediate seams of letten. "This, its greatest thickness," says Heer, "may enable us to calculate the period of time requisite for the formation of this bed. From the mode and manner of the compression of the stems of the trees, from a comparison of the carbonaceous constituent of slate-coal with that of the peat, it follows that these coal beds, when in the condition of peat, ought to have been six times thicker, that, consequently, the above coal-bed of ten feet thickness must have originated from the compression of a peat-bed sixty feet high. Assuming, on the average, an increase of one foot of peat within a century, we obtain 6,000 years.

"Another mode of calculation leads to the same result. An acre of slate-coal ten feet thick contains, according to Mine-Superintendent Stokar-Escher, 96,000 hundred-weights of carbon. On assuming that an acre of peat-land produces annually fifteen quintals of carbon, 6,400 years would be required for the formation of the above-mentioned coals. The assumption of an annual production of fifteen quintals of carbon (based upon the assumption that a foot of peat is formed within a century), is rather too high than too low, for according to Liebig's interesting researches, an acre of wood plantation produces annually but ten quintals of carbon, in which case the formation of the above coal-bed required 9,600 years."

In these calculations it is certainly assumed that the climatic conditions resembled those at present existing. As the same species of plants, which now produce peat, formed the slate-coal,

there is no reason to suppose that the climate differed widely from the present; at any rate, it may be safely assumed that thousands of years were required for the formation of the aforesaid beds.

But whether six or ten thousand years were requisite for their formation, these slate-coals occupied but a small fraction of the diluvial period. They overlie thick glacial clay, and are themselves covered with flint and sand-banks, thirty feet high and with floated glacial blocks on the top. Despite of the immense period of time which separates these coal deposits from historical time, during which not even the thin stratum of vegetable earth was completely formed, these coal formations still belong to our geological period, though to the beginning of it; for we have seen that there grew in them the same marsh and peat plants, and the same trees, as are still extant in that region. We should, nevertheless, add, that there occur some species, as the hazel, which differ from living species; but the same character which manifests itself in the animal world shews itself also in the vegetable kingdom. Some species have become perfectly extinct, others have retreated northward, or to the mountains, but most continue to live in the same region.

The coal beds in eastern Switzerland are specially interesting on account of the animal world they contain. Small fresh-water snails of still living species are as abundant as small marsh-beetles, whose glittering wing-sheaths, often closely compressed, form the surface of the beds. There occur, also, coleoptera, which belong to extinct species, like the trunk-beetle, etc. There were also found teeth of the deer and bear, remains of the elephant and rhinoceros (not of the mammoth and the rhinoceros with a bony septum), but of an elephant resembling the Asiatic *(Elephas antiquus)*, and the rhinoceros with a semi-osseous septum *(Rhinoceros leptorhinus)*, both of which occur with the bones of man, but seem to have become extinct at an earlier period than their hairy cognates. From this fact follows the deduction, confirmed indeed by the stratification, that the slate coals of eastern Switzerland had been formed upon the glacial clay immediately after the retreat of

the glaciers, that the old thin alluvium covered them, and that, consequently, the beds in which occur the mammoth and the rhinoceros with the bony septum, are of a somewhat later date than the slate-coal beds.

We now make a long stride to the north, where the glacial formations attained the greatest extent.

Kjerulf very properly directs our attention to the observations of Rink, who passed several years in Greenland, where he studied the ice of the interior, the so-called "iceblink." There we find a continent not less in extent than the whole Scandinavian peninsula, covered with an ice-crust 1,000 feet in thickness, moving from the interior towards the west coast. This mass of ice, laden with stone blocks, advances slowly but steadily towards the west coast, where it breaks up into large fragments, which, in the form of icebergs, often of colossal dimensions, are carried by the sea currents in definite directions, even to the Azores. They gradually melt, and deposit their freight at the bottom of the sea.

The same phenomenon formerly occurred in Norway, Sweden, and Finland. The country lay shrouded beneath an enormous ice-mass, which carried its substratum of pebbles and gravel into the sea. The whole rocky mass of Norway was polished and grooved, but the frozen sea, which surrounded this prehistoric Greenland, stood at a lower level than at present, for in many places the dragged surfaces stretch far out beneath the present sea-level. Though this circumstance alone may not be sufficient to explain the refrigeration of the northern continent to the same degree as that of Greenland, the greater elevation of the land above the sea may have contributed to it. Whenever the tracts of the glaciers show beneath the present sea-level, the waters must have been lower, for the ice is melted and undermined by them, as shown by the polar glaciers at ebb tide.

The sea rose, the land became warmer, the ice-shroud melted, the highest ridges showed their pinnacles, the ice broke into separate glaciers, which continued to fill up the valleys. Now we find moraines as in our present glaciers; medial and terminal moraines; walls, the extremities of which now stretch towards

the sea, or are found as terminal barriers in the valleys. The sea rose about five hundred feet; for up to this height we find deposits of molluscs, which belong to the Arctic sea. These enormous ice-masses furnished, at the same time, large streams, which here and there obstructed by the terminal embankments of the glaciers, formed large inland lakes, and deposited the finely-ground material, carried by them, in the form of loam, marl, and sand-clay. The sea on the one hand, and the inland lakes on the other, worked on the masses deposited by the ice; the glaciers brought down erratic blocks, and these were either directly or indirectly, after floating on the icebergs, deposited upon the banks. Thus the present period was gradually induced, when glaciers stretch to the sea in but few spots, but rise in other places considerably above the sea-level, and where in the valleys a milder climate prevails.

This pre-historic history is no romance; it is derived from actual facts and the deductions therefrom. The facts are thus summarised by Kjerulf:

"What is the prevalent order of the glacial deposits? Quite at the bottom, where they could not be washed away, are sand and pebbles. This is '*sheuer-sand*' (scoring-sand), and '*scheur-steine*' (scoring-stones). This is the material which, pressed by the ice, was carried above the rocks. These blocks should be examined, if we wish to estimate the direction of the motion. But as for the most part they are smaller, much broken, and frequently rounded, they are termed pebbles (rolled stones), though this is an incorrect name, they should therefore be distinguished as 'scheuer-steine.' They are not rolled, but have been crushed against each other, and being inserted into the ice, like diamonds in the glazier's pencil, they have drawn lines and furrows upon the stones. Above this 'scheuer-sand' and the pebble banks lie the various kinds of clay, first, calcareous, marly clay, in districts accessible to the glacial waters which brought down the ground up lime and clay from the Silurian beds; next above, the shell-clay, where the elevation was not too high; then comes brick-clay, without shells, derived probably from the period when the flood from

the interior was at its highest; then comes sand, and, quite at the top, loam.

"The large erratics lie above the banks of pebbles, loam, and sand; they are in Scandinavia, in a less degree, deposited by floating ice-rafts, but mostly directly by the glaciers."

"We have thus before us a period, a real ice-period, and an ice-sea, which washed the glacial coasts of Scandinavia and Finland, then constituting one continent. But the proofs of such an Arctic sea apply not only to this ice continent. The north German plains, from Holland to Russia, are covered with blocks, pebbles, and drift, all of which are derived from Scandinavia and Finland, the southern boundary of which is along the elevation of the land, which is limited by the Weser mountains, the Hartz, the Bohemian, and Giant mountains. In the east, the tracts of these erratic blocks wind through the Russian lowlands towards the Ural so regularly around Finland that they describe almost a circle. This is the dispersion circle, so to speak, of this ice sea, within which the blocks carried by the icebergs were stranded, and the mere circumference of this block line shows, that at the time of the greatest extension of the ice sea, the Scandinavian-Finnish continent was an island, whilst a broad ice arm connected the present Polar sea, and the White sea with the Baltic."

In the whole extent, from the North American continent down to New York, in England and Scotland, in Scandinavia and Finland, in Russia, as far as the steppes of Petschora (Peczora), are found the same formations, the polished, striated, and furrowed surfaces, the gravel banks, and above them the clays, marls, with specific northern marine molluscs, or with species which attain their proper size only in the north, but which diminishes in the south.

Sars has, by his minute investigations, succeeded in determining the highest level of the ancient ice-sea, and the periods of retreat, whilst Lovén proved that Denmark was connected with Norway, that the White sea must have been connected with the Baltic by a broad arm, which wound round Finland, and that the Swedish Wener- and Wetter-lakes, now several

hundred feet above the Baltic, must have been connected with this ice sea, as several species of crustacea still inhabit these lakes, the relics of this ice population. Already, in 1846, my friend Desor had proved, in a treatise, that there prevails the greatest analogy between the phenomena in the north and those of the Alps, and that the peculiarities which distinguish the northern phenomena are due to the alterations in the level, by which the sea on the Scandinavian coasts rose, then again gradually subsided down to the present time, during which the elevation of the Scandinavian soil is still continuing. During the last period there were formed, as in Switzerland, here and there, glacial necks, which produced those confusedly stratified ridges upon the surface of which lie angular blocks known by the name of "Oesars." In the interior of the high valleys, just as in the lake basins of Switzerland, were heaped up moraines, which at times attain a great size. All this has been confirmed by Martins, so that we can add nothing fresh as regards the north.

The process was the same in the North-American continent, with this difference, that but little of the land was there submerged under the sea, but large fresh water-lakes were formed, the deposits of which prove that the present lakes on the Canadian boundary are only the remnants of the inland fresh water lakes.

On turning to England, we find an analogous series of phenomena. At the bottom, boulder-clay resting here and there upon fresh water formations, alluvium, and pebbles; above them, in the mountainous regions, as in Scotland and Wales, moraines testifying of glaciers which descended into the valleys. Everywhere the same phenomena in the same succession, only so far modified, that in the north it is the sea, in the south it is the fresh water which predominates in its action.

The following table shows on the one hand the synchronism of the glacial clay in different countries, and on the other hand the synchronous appearance of the mammoth (*Elephas primigenius*), and the rhinoceros tichorhinus, which in some parts of the European continent were the contemporaries of man.

SYNCHRONAL TABLE OF DILUVIAL

Scandinavia.	Great Britain.	Belgium, North Germany.
Kitchen refuse (Kjökken-möddings). Older Pine Period of the turf-moors	Loam.	Modern alluvium. Loam. Mecklenburg graves ?
Upper Moraines in the valleys. Pebbles in the lower valleys. Oesars.	Sand, with fresh water snails. *Elephas primigenius*, *Rhinoceros tichorhinus*. Stone hatchets, near Hoxne, Icklingham, on the Ouse. Caves, with *Ursus spelæus*, *Hyæna spelæa*, and hatchets.	Caves of Liège with *Elephas primigenius*, *Rhinoceros tichorhinus*, *Ursus spel.*, etc. Man of Engis, Engihoul, and Neanderthal.
Greatest height of the Ice-Sea. Bed with glacial molluscs.	Clay, with wood (oaks, yew, pine), near Hoxne. Old alluvium (drift), with pebbles. Clays, with glacial molluscs, on the Clyde.	Blocks of the North-German plain transported from Scandinavia.
Glacial tracts beneath the present sea-level, with scoring stones.	Glacial clay with blocks (boulder-clay).	
	Sunken forest and fluvio-marine formations, near Cromer, with *Elephas antiquus* and *meridionalis*, *Rhinoceros etruscus*, etc., with oaks, yews, firs, etc.	

FORMATIONS DOWN TO THE PRESENT TIME.

Valleys of the Seine, Somme, Yonne, etc.	Vogesen, Vosges.	Rhine Valley and South Germany.	Switzerland.
Caves of Lombrive with man, Ru-rochs, rein-deer, etc. *Diluvium rouge.* Loess and clay of Paris, Amiens, Abbeville, etc.			Loam and modern alluvia.
Diluvium gris with *Eleph. primigen.*, *Rhin. tichorhinus*, Man of Amiens, Abbeville, Paris, etc. Caves with *Ursus spelæus*, *Hyæna spelæa*, etc.	Terminal moraines in the valleys.	Loess and loam of the Rhine-valley, of the Neckar-valley, with *Elep. prim.*, *Rhin. tichor.*, etc. Terminal moraines in the Black Forest.	Stratified diluvium with *Elephas primigenius*, *Rhinoceros tichorhinus*, etc. Older alluvia. Terminal moraines near Zürich, Sempach, Bern, Geneva, etc.
Diluvium of the plateaux.	Vosge-gravel.	Vosge-&Black-Forest gravel.	Slate-coal with *Elephas antiquus*, *Rhinoceros leptorhinus*, near Dürnton, Utznach, Mörshwyl.
	Alpine gravel.	Gravel of the Bavarian plateau.	Glacial clay and marl with blocks and scoring stones. Erratic blocks on the Jura. Greatest glacial extension.

Our table embraces only the earliest appearance of human remains in Belgium, the north of France, and the south of England, phenomena which are well attested. The animal world, which is associated with man in the pile-buildings of Switzerland, for instance, leaves no doubt that man settled in these regions at a much later date, where, as proved by the caves of Besançon and in Appenzell, the cave-bear existed, which in Belgium was the contemporary of man. We have thus, in the earliest geological period of man, some indications of the migrations and spread of mankind; for this much at least results from the skulls found, that the oldest human remains found in Switzerland belong to a different race, which cannot have immigrated from Belgium.

In whatever way we examine the facts, we are constantly led to the inference that the so-called diluvial period lasted an incalculably long time, during which considerable elevations and subsidences of land and sea, and many alterations of the surface of the globe and its inhabitants, plants and animals, took place both in restricted localities and large districts.

That man appeared in our hemisphere only in the course of this long period, and that, hitherto, no traces have been found of man's earlier appearance is an admitted fact; but whether man appeared before, or after the last glacial extension on our continent is still an open question. After a careful examination of the facts, we adhere to the latter alternative, as we have only found proofs of man's appearance after the great glacial period, after the formation of the glacial clay in Scandinavia, England, and Switzerland. We are, however, quite ready to abandon this position, and to assume a greater antiquity of man, as soon as human remains are found under the glacial clay or under undisturbed tertiary strata.

This difference of opinion renders man chronologically neither older nor younger. Whether, or not, an intermediate glacial period occurred, an immense period of time was requisite to heap up drift thirty feet high above the worked flints, specially as this accumulation proceeds but very slowly.

We must confess that all the efforts hitherto made to determine the period in time of man's first appearance have hitherto been unsuccessful. We must, however, mention them, though

they refer to human remains of a considerably more recent date than the stone hatchets and the jaw of Amiens, or the skulls of the Belgian caves.

One of these calculations is founded on the Delta of the Mississippi. The alluvial deposits must have been continued for an indefinite period; for near New-Orleans, at a depth of six hundred feet, the bottom of the deposits had not been reached. The plain on which New Orleans stands rises only nine feet above the level of the sea, and the excavations made pass far below the sea level. In these excavations are seen superimposed beds of cypress forests *(Taxodium distichum)*. On laying the foundations for the gas-works, the Irish navvies had to give up the task, as they had to dig out wood instead of soil. They were replaced by woodcutters from Kentucky, who cut their way down through four superimposed layers. The lowest was so old, that the wood cut like cheese. The section of the banks also showed sunken forests, whilst stately live oaks grew upon the banks, indicating that the surface had not changed for years.

In that part of Louisiana where the water-height presents greater differences than in New-Orleans, Dickeson and Brown have traced ten distinct cypress forests at different levels below the present surface. These groups of trees, the live-oaks on the banks, and the successive cypress forests, are superimposed upon each other, as may be seen in many places in the vicinity of New Orleans.

Dr. Bennet Dowler has made an interesting computation as regards the emergence of New-Orleans, in which these cypress forests play an important part. He divides the history of this event into three epochs:

"1. The era of colossal grasses and waving prairies, as seen in the lagoons, lakes, and the sea coast.

"2. The era of the cypress basins.

"3. The era of the present live-oak bank."

Many districts on the Mississippi show that the development from the water proceeds in the order named. First appear the grasses, then the cypress, and finally the live-oak. Assuming an elevation of five inches in a century (the rate of the Nile

deposits), we obtain 1,500 years for the era of aquatic plants until the cypress era. Supposing ten feet to represent the size of one generation of trees, we obtain a period of 5,700 years as the age of the oldest trees now growing in the basin, for they measured from ninety-five to one hundred and twenty rings of annual growth to an inch; and according to the lowest ratio, a tree of ten feet in diameter will yield 5,700 rings of annual growth. Though many generations of such trees may have grown up and perished in the delta of the Mississippi, Dr. Dowler, to avoid all cavilling, has only assumed two successive growths, including that now standing: this gives for two cypress generations the age of 11,400 years.

The maximum age of the oldest trees on the live-oak bank is estimated at 1,500 years; one generation only is counted. Thus we obtain the following data:—

Era of aquatic plants - - - -	1,500 years.
Era of cypress basin - - - -	11,400 ,,
Era of live-oak platform - - - -	1,500 ,,
Total period - -	14,400

Each sunken forest must have had a period of rest and gradual depression, estimated as equal to the era of live-oaks, which of course occurred only once in the series. We then certainly keep within the limits of probability in assuming each period of elevation to have been equivalent to the one above arrived at, and as there were at least ten such changes we reach the following result:—

Last emergence as above - - - -	14,400 years.
Ten elevations and depressions, each equal to the last emergence - - -	144,000 ,,
Total age of the Delta -	158,400

In the excavation of the gas works, burnt wood was found at the depth of sixteen feet, and at the same depth the workmen found the skeleton of a man. The skull lay beneath the roots of a cypress tree belonging to the fourth forest below the surface. It was in good preservation, but the other bones crumbled into pieces on being touched. The cranium no doubt belonged to the American type.

Assuming, as above, the present era at 14,400 years, and adding three subterraneous groups, each equal to the living, (leaving out the fourth, in which the skeleton was found), that is to say 43,200, we obtain a total for the age of the skeleton of 57,500 years."

The data requisite for this computation are so simple that the result can scarcely be cavilled at.

Between 1851 and 1854, two sets of shafts and borings were sunk in Egypt, the one in the latitude of Heliopolis, where the valley is sixteen miles broad, the other near Memphis, where the valley is but five miles broad. All the remains, such as land-shells and bones, belonged to living species, bones of the ox, hog, dog, camel, and ass, were very common.

There were also found pieces of burnt brick and pottery, one piece at a depth of sixty feet. If now it be correct that the increase of Nile-mud is at the rate of five inches in a century (in the Delta the rate of deposit is less, namely, $2\frac{1}{4}$ inches), then the piece of burnt brick, found at a depth of sixty feet in the Nile-mud, would be 12,000 years old, which can scarcely surprise us, as the Egyptian King Menes lived about 5,000 years before Christ, and before him Egypt had attained a high degree of civilisation, and possessed at least two important cities, Thebes and This. If 7-8,000 years ago, that is to say, at the time of the biblical Adam, flourishing cities were standing, we need not wonder that some thousands of years before the existence of these cities, the art of brickmaking was known.

The discoveries in the peat-bogs, specially of Denmark, where, as in the Delta of the Mississippi, superimposed generations of forests are met with, consisting of trees, at present not existing in Denmark, also testify to a high antiquity, though I am not aware that any attempts have been made to compute the duration of the turf-moors from the annual rings of the trees.

The great antiquity of man reaching back to the period of the cave-bear, being thus established, it is as easy to prove that man, the contemporary of the cave-bear, cannot have immigrated from afar. The structure of his cranium presents no resemblance to that of any European race, still less to any Asiatic; for in Asia,

and specially in Central Asia,—the supposed cradle of humanity,—the short form of head predominates, and if longheads are found they bear no resemblance to the longheads of the caves. At most, it might be assumed that Paradise was situated somewhere in Australia, whence these ancestors, of a simious type, emigrated. It is not our business to pursue speculations of this kind.

There is, however, one matter to which, before I conclude this lecture, I would draw your attention. There exists not a single fact which in any way indicates a general flood, a deluge, which reached the highest pinnacles, destroying all living beings excepting such of our ancestors as found refuge in the Ark of Noah. We find, indeed, everywhere phenomena indicative of a greater height of the waters, but they nowhere rose very high above the valleys, still less did they cover the summits of the highest mountains. Nowhere are there traces of sudden flood-catastrophes, everywhere we merely observe the slow workings of such forces as still act. We have thus everywhere an opportunity of making observations which induce us to consider the tradition of a general deluge as a myth. Many times has it been pointed out that the loose cones of volcanoes, built up of scoriæ and ashes, specially of the extinct volcanoes of Auvergne and the Rhine, could never have resisted the force of a general flood; nevertheless, within the sight of these cones, which must have existed at a more remote period, the old tale is constantly repeated. The sun is now left in peace; he no longer walks the heavens but remains fixed. Shall we have to protest, as in the former case, for two centuries, before they give up the opening of the flood-gates of heaven and the fountains of the deep, to drown "sinful beast and man"?

LECTURE XII.

Stone Period in the North.—Refuse-heaps.—Peat-bogs.—Graves in Denmark and Mecklenburg.—Grotto of Chauvaux.—Pile-works on the Swiss lakes and moors.—Civilisation of the Stone Period.—Agriculture of the Pile-builders.—Skull of Meilen.—Pile-works in Italy.—Chronological Calculations of Morlot, Gillieron, and Troyon.—Pious Fancies of the latter.

Gentlemen,—In pursuing our investigations concerning the relics of man, we first turn to the North, which furnishes us with most of the facts belonging to the pre-historic period of humanity. It is but the traditions of a comparatively modern period which direct us to the East, and which induce us to search in High Asia or India for the cradle, not of humanity, but of such tribes, or rather languages of the tribes, which now inhabit Europe. As regards the events of a period reaching further back, we find no connection with Asia, but traces of an intercourse between the north and north-west with central Europe and Switzerland. The discovery of northern antiquities has thrown much light on the earliest period of mankind accessible to us, and has been the more productive, because the investigations of the facts have not been carried on exclusively by antiquaries, but by naturalists also, who with singular industry and ingenuity knew how to avail themselves of apparently insignificant facts, for the explanation of the most difficult problems. The name of Steenstrup, who was also well versed in other branches of natural history, shines here in full splendour. I shall give you the results obtained by him, Forchhammer, and Worsaae, as contained in the condensed and excellent account of Morlot, since the original is in Danish, and it cannot be expected of us naturalists that we should be acquainted with the languages of all minor nations.

On several spots on the coast of northern Denmark, specially

in the vicinity of the Fjords, where the surf is moderate and immediately on the sea shore, a few feet above the present level, may be seen shells-mounds, three, five, and even ten feet high, extending in length to above one thousand feet, with a breadth of one hundred and fifty to two hundred feet. Here and there these heaps lie around a free space, which seems to have been a place of habitation; it is only by way of exception that these heaps are found on the land at a distance from the coast, or much above the level of the sea. These shell-banks are not formed by nature, which would indicate a greater height of the water. But few species are found, all in the adult state, species which do not inhabit the same depth. These shells are intermixed with broken bones of animals, flint implements, coarse pottery, coals, and cinders. There is no doubt that these heaps are *kitchen-refuse*; that a people dwelt there who lived on molluscs and animal food, and cast away the shells and bones. The northern scholars thus termed these mounds *Kjökkenmöddinger* (kitchen-refuse), by which name they are now generally known. In some spots there is seen upon these accumulations a thin layer of gravel and pebbles, deposited by the sea, but mostly they are covered with vegetable earth and green sward.

The exploration of these refuse-heaps led to the following results:—Of vegetable matter, but few fragments of burnt wood are found. Here and there are seen peculiar-looking heaps of ashes, which from the large quantity of manganese they contain, seem to be derived form the *Zostera marina*, a sea plant which, some centuries ago, was still burnt in that country for the extraction of the salt. These mounds testify thus to a similar industry in a remote period. Among the shells the most common is the oyster (*Ostrea edulis*), the cockle, mussel, and periwinkle (*Cardium edule, Mytilus edulis, Litorina litorea*) all which are eaten at the present day, and still inhabit the same sea, but are now not so large, and have in some parts, where these mounds occur, entirely disappeared.

That the decrease and disappearance of these edible molluscs is to be attributed to the fisheries cannot well be assumed; but even the diminution of the salt in the Baltic, to which the above

effect is attributed, does not seem to us a satisfactory explanation. The Romans succeeded in transplanting oysters into the freshwater lakes near Naples, where they still live and propagate, and even mussels and periwinkles thrive well in brackish water as well as in lakes periodically filled with fresh water. The cause of the phenomenon must therefore be sought elsewhere: in that slow transformation and alteration of the sea-bottom, which has been found in oyster beds, and which is chiefly produced by *tubicolœ,* which overgrow the oyster beds and destroy them.

Besides the shells mentioned above, there are found others of species still living in the Danish waters, though in smaller quantities, such as *Buccinum reticulatum* and *undatum* ; *Venus pullastra,* which do not seem to have been much relished by these old mussel-eaters.

But few remains of the crab are found, but many of the herring, cod, lemon sole *(Pleuronectes limanda),* the eel, the latter being chiefly found where it abounds at present. Of birds, besides several species of wild ducks and geese, are found the remains of the wild swan, woodcock, and the great auk *(Alca impennis),* which died out (Iceland its last refuge) in 1842. The capercailzie *(Tetrao urogallus)* is no longer seen in Denmark, as the firs, on the sprouts of which it fed in the Spring, have now mostly disappeared, whilst formerly they were very abundant, as shown by the exploration of the peat bogs. The swan comes to Denmark in the Winter only, proceeding in Summer further north to Iceland ; but as even the auk, which took refuge there, was formerly in all the Northern Seas, in Denmark, the Faroe Islands, and the Hebrides, very abundant, there is nothing against the assumption that the swan formerly passed his summers in Denmark. Small land birds were not found, the common fowl was entirely absent.

Of quadrupeds, the bones found belonged to the stag, the roe, the wild hog, the beaver, the seal, and the now extinct 'urochs' *(Bos primigenius),* which seems, among our present races, to have left as his progeny the heavy Friesland cow. Of the Lithuanian Bison, or Auerochs *(Bos urus,* or *Bison Europæus)* which is a distinct species, and formerly spread over all Europe,

there have been traces found in the peat bogs, but not in the kitchen-heaps. It is remarkable, that the reindeer, the elk, and the hare, which no doubt then existed in Denmark, are also absent; on the other hand, bones of the wolf, the fox, the lynx, martin, the otter, the wild cat, the hedgehog, and the water-rat are met with. The only domestic animal was the dog, a race resembling the setter, the existence of which is also proved by the circumstance that only the long bones of birds are found, which these dogs usually reject.

All tubular bones are broken, or split open lengthwise to get at the marrow, and if the cavity, as in ruminants, is divided by a septum, the blows are given on both sides. The marrowless bones are unbroken, but gnawed, specially where they are covered with cartilage. The teeth impressions are partly those of dogs as well as of man. All animals seem to have served for food; for the bones of carnivora, and even of the dog, are split like those of ruminants. The meat was either boiled or roasted; for in the kitchen-heaps are found stones of the size of a closed fist, arranged so as to form a hearth about two feet in diameter, around which coals and ashes are seen. There are also pieces of coarse pottery, made by the hand; the clay is mixed with angular pebble fragments. There are also found in these kitchenmiddens rude flint tools, hatchets, wedges, and knives, the incisions of which can be easily traced upon the bones. It was at first believed that the people of these kitchenmiddens were ignorant of the mode of sharpening and polishing their implements, but as some well worked tools were found, and the incisions upon the bones are so deep that they could only have been made by sharp instruments, it is probable that the people of that period only used the rude flints for opening shells or breaking bones, considering their finer instruments too valuable to be used for such a purpose.

The turf moors of Denmark supplement the evidence derived from the kitchenmiddens. Besides the meadow moors, in and near the water basins of the valleys, and the high moors scattered upon the plain formed of mosses, there are in Denmark peculiar little forest moors *(Skovmose)*, which fill up deep hollows in the subjacent boulder formation. On the steep

walls of these funnel-shaped pits, frequently above thirty feet in depth, grew, at the time of their formation, trees which sank so gradually that the tops are turned towards the centre of the bog. In the centre of the bog there is generally at the bottom a clay bed, then a stratum of turf, frequently mixed with lime and microscopic plants, above which lies the proper moss-peat. Firs grew sometimes upon these moors, but did not seem to thrive, and were, at a later period, replaced by the common moor-shrubs *Vaccinnium oxycoccos* and *uliginosum*, the *Erica tetralix* and *vulgaris*, the birch, elder, and hazel. Around the borders of the bogs, where large trees grew, the forest vegetation presents a remarkable change. There we find firs *(Pinus sylvestris)* of great height, often three feet in diameter, which are only distinguished from our common firs by a thicker bark. The rings indicate an age of several centuries. This fir no longer grows in Denmark, nor has it existed there within historical times, nor is there any tradition that it was ever known to the inhabitants of Denmark. These firs frequently stood so thick that by falling into the bogs they formed a kind of floor.

The firs disappeared and were supplanted by oaks *(Quercus robur sessiliflora)*; stately trees, often four feet in diameter; these have also disappeared, or nearly so. In the upper layer of the peat is found the summer oak *(Quercus pedunculata)*, with the birch, the hazel, and the alder. At present the Danish forests are formed by the common beech, which is not found in the surface of the forest bogs. The presence of the woodcock in the kitchenmiddens proves that the people who formed them lived during the fir-period, and that since then the oak vegetation also passed away, the remains of which are found in the forest bogs, and which has been superseded by the beech. Fir-trunks were found worked by the hand of man, and between these trunks flint implements, which establish the parallel with the kitchen-middens, whilst in the turf-moors, which correspond with the oak period, fine bronze tools were found.

Human bones were neither found in the kitchenmiddens nor in the peat-bogs of the fir-period; but graves were discovered composed of large stone blocks, in which only stone- and bone-implements were found. The skulls found in these graves are

remarkably small and very round, the occiput short, the orbits very small, the supraciliary ridges much projecting, the nasal bones very prominent.

Fig. 101. Borreby Skull of the Stone Period (Denmark), after Busk.

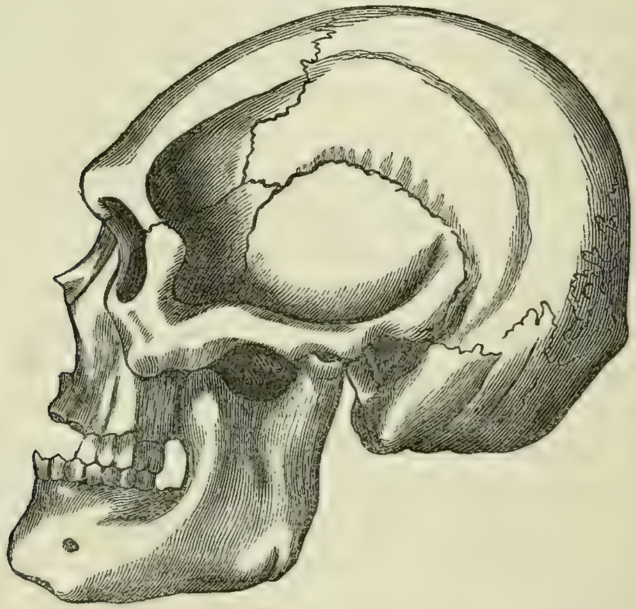
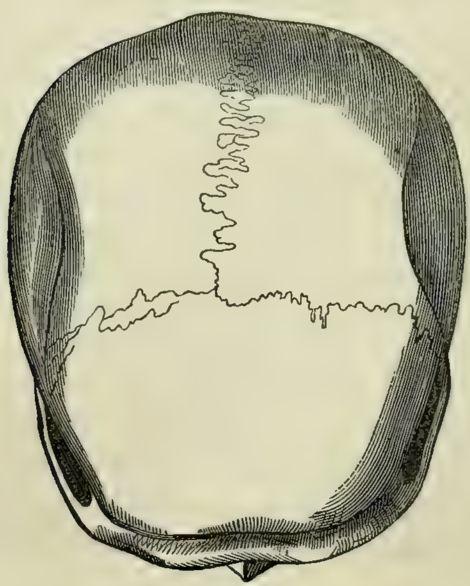


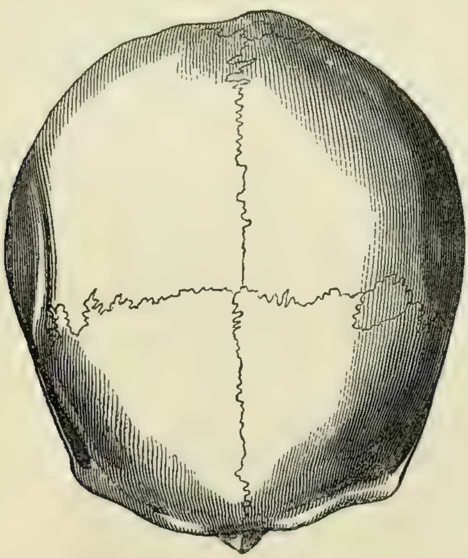
Fig. 102. Borreby Skull, top view.



Between the supraciliary arches and the nasal bones there is a depression large enough to receive the index finger of an adult. The forehead is usually flat and retreating, though not so much as in the Neander skull. The mean proportion of length to width in twenty skulls is, according to Busk's table, which he kindly sent me, as 100 : 78. The vestiges of the facial muscles are strongly marked, the alveolar margins prominent, the teeth used up obliquely. The skulls resemble the Lapp skulls by their rotundity and smallness, but are distinguished by the depth of the nasal suture and the oblique position of the anterior dental margins. They resemble, at all events, no other European race than that high Northern people, or perhaps the Fins, whose customs are indicated by the builders of the kitchenmiddens.

A comparison of these skulls of the stone period with the Lapp skull on the one hand, and the Romanic skull on the other, yields the subjoined results :

Fig. 103. Skull of a Lapp, top view, after Busk.



On comparing the top of this Lapp skull with that of a stone-period skull of Borreby (fig. 101), and the Romanic skull (fig. 127) a series is presented in which the Lapp occupies the middle. In all these three skulls the zygomatic arches are, in this position, scarcely visible ; the forehead behind the eyes is thus pro-

portionately wide, and the temporal fossæ are but little depressed in the upper portion towards the vertex. The Romanic skull is the widest; were it not for the slight depression towards the zygomatic arches and the narrowness of the forehead, the contour of the head would be nearly circular. The Lapp occupies the intermediate place; the contour of his head corresponds to that of a short thick egg, with a flattened and narrowed anterior end. The malar bones at their junction with the zygoma project more, and on this account render the aspect of the frontal region wider. Whilst in the Romanic skull the posterior contour forms a flat arch somewhat depressed in the centre, it is in the Lapp more curved and somewhat projecting in the central line. The greatest width of the Romanic skull is in a backward direction almost opposite the last quarter of the central longitudinal line of the skull, whilst in the Lapp it is in the last third of that line.

The stone skull (fig. 102) is still narrower than the Lapp skull, and by the projection of the supraciliary arches which is wanting both in the Romanic and the Lapp skull, the front part of the oval which forms its contour is nearly as wide as the posterior section. The zygomatic arches project somewhat more; the temporal lines are more deepened; the frontal protuberance forms a continuous *col* before the contour of the receding narrow forehead. All this indicates a greater muscular development, which, however, but little influences the cranial structure, which is decidedly longer and narrower; the greatest width is almost in the middle, but not so pronounced as in the Lapp and the Romanic skull.

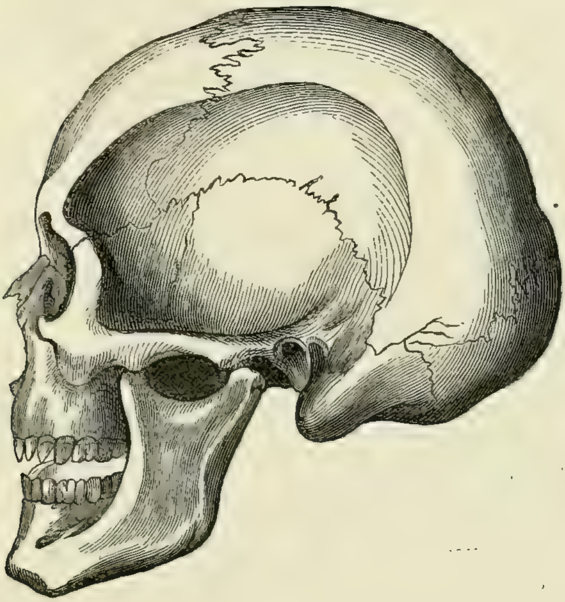
The proportions of the head measurement confirm this view: the mean in the stone skulls measured by Busk is = 78, 2; in the Lapps = 87, 8; in the Romanic = 92, 1.

I must, however, observe that the differences between the stone skulls of various localities and the different sexes are by no means insignificant. The skulls of Borreby are the widest the mean of the head-measure being = 81, 3; the skulls from other localities are narrower, the mean being = 75, 1; whilst the supposed female skulls are = 79, 8.

On viewing these heads in profile, there is also found no slight

difference. The Lapp head approaches more decidedly the stone skull of Borreby (see fig. 101) than the Romanic skull (see fig. 126).

Fig. 104. Profile of a Lapp Skull, after Busk.



It is true that in the Lapp skull the frontal protuberance is scarcely indicated; the forehead is much higher and more arched, the vertex more situated in front, the occiput more projecting, and there is something like a break in the lambdoid suture; the nasal root is less drawn in, and the front teeth are perpendicular, whilst in the Borreby skull, the alveolar margins of the upper jaw shew a decided tendency to prognathism, which, if the teeth were not wanting, would be plainly seen; but it must not be forgotten that the skull of Borreby which I give is that which presents these characters in the greatest degree, and that in the rich collection of drawings from the stone period, kindly sent me by Professor Busk, I find some which almost exactly correspond to the Lapp skull. Thus, apart from size, which is somewhat greater in the stone skull, a female skull of Borreby, marked No. 1, all but covers in profile the Lapp skull.

The Romanic skull (fig. 126) maintains also here a separate position. The high arching of the forehead, the uniform curvature of the vertex, the steep descent of the occiput, the compactness of the base, the acclivous direction of the upper jaw and the mastoid processes, distinguish it at the first glance; and, viewed in profile, it appears almost as the polar opposite of the stone skull. The position also of the *foramen magnum*, which is not seen in our drawings, is more backward in the Romanic skull than in the stone- and Lapp-skulls.

The Lapps present thus in their cranial structure a greater affinity with the stone-period people than with the Romanic-type; and the latter must have undergone a much greater alteration than the former, if both types are to be derived from the primitive people of the northern stone-period.

There can be no doubt that during the stone-period, as it is called by archæologists, when metals were unknown, the north had attained to a certain degree of civilisation. This is partly proved by the finished tools made of stone, bones, and wood, found in the peat bogs, and by the old graves, all of which bear a common character, being a chamber formed of large stone blocks, in which the corpse was deposited or placed in a crouching position. Upon this chamber large masses of stone were heaped, and thus arose those large mounds which attract the attention of the traveller in the northern plains, mounds frequently overgrown with high trees—oaks or beeches. In many places, besides Switzerland, the custom prevails for wayfarers to place upon the grave of one accidentally killed a stone or a handful of earth. Possibly, a similar custom may have obtained among the ancient stone-peoples, and may have contributed to these accumulations above the graves.

Whether bronze was introduced by a distinct race, or whether the art of making it was discovered by the stone-people, must for the present remain undecided. No skulls of the bronze age have as yet been discovered, probably from the custom then prevalent of burning the bodies and preserving the ashes along with the arms and other tools of the deceased. It was at the iron period that the burial of bodies recommenced,

whence are derived those long heavy skulls, which differ entirely from those of the stone-age.

The Lapp people of the stone-period, if we may so call it, inhabited not merely Denmark and Scandinavia, but no doubt also the north of Germany. Discoveries made in Mecklenburgh furnish the clearest evidence for such an assumption. I shall give you a description of them nearly in the words of Dr. Schaaffhausen, who also gives a minute description of the skulls found.

"There was found near Plau in Mecklenburg, in the gravel, six feet under the surface of the soil, a human skeleton, in a crouching, almost kneeling, posture, with implements made of bone, a hatchet made of staghorn, two wild boar tusks which had been cut off, and three incisors of a stag, perforated at the root. This grave was considered to belong to a very remote period, as it was neither protected by stones, nor were there any implements of stone, iron, or pottery present. Dr. Lisch, struck by the abnormal projection of the supraciliary region, observed, that the cranial formation indicated a very remote age, in which man occupied a very low position in the stage of development, and that the grave probably belonged to an autochthonous people. The skull and the skeleton having been broken to pieces by the workmen, I had some difficulty in cementing the twenty-two fragments sent to me. Notwithstanding the great similarity between the form of the forehead of this skull and that of the Neander-skull, the prominence of the supraciliary arches is greater in the latter, and is confluent with the superior orbital margin, which is not the case in the former. The skulls, however, are essentially distinguished by their general form, which, in the latter, is long-elliptical, and in the former, rounded. In the Plau-skull, a portion of the upper jaw, with the teeth, and the whole lower jaw, have been preserved; it is orthognathous. The bones are thick but very light, and adhere strongly to the tongue. The muscular attachments on the occiput, above the mastoid process, are strongly developed; the sutures of the cranium are wholly unossified; the last upper molar on the right side has not yet broken through; the teeth are worn away; in

some of the molars, the entire crown has almost disappeared; the lower canine teeth are much larger than the incisors, and rise above the row of teeth; the *foramen incisivum* in the upper jaw is very large, exceeding in width four millimeters. The ascending ramus of the lower jaw rises at a right angle, and is broad and short. The muscular attachments are also well marked on the lower jaw. On the right parietal bone is an elongated depression as from a blow. The proportional dimensions are as follows :—

	Millimeters.
Cranial circumference over the supraciliary ridges and the semicircular lines of the occiput	445
From the root of the nose, over the vertex, to the superior semicircular line	320
From the root of the nose, over the vertex, to the occipital foramen	380
Length of skull from the glabella to the occiput	168
Breadth of the frontal bone	107
Height, from a line connecting the temporal borders of the parietals, to the middle of the sagittal suture	80
From occipital foramen to the same point	122
Width of the occiput from one parietal protuberance to the other	138
Width of base from one mastoid process to the other	155
Thickness of the frontal and parietal bones in the middle	9

The cranial capacity, measured by millet-seed, amounts to 36 ounces, 3½ drachms, Prussian apothecaries' weight."

A similar discovery was made near Schwaan, in Mecklenburg, but the cranium is far from being so well preserved as that of Plau. I might here mention some discoveries in the Baltic provinces of Russia, described by Dr. Kutorga, had not his authenticity been found to be rather suspicious. The skulls in question were found in the Government of Minsk, in the sand of an old river-bed.

I must, however, dwell at greater length on a discovery made by Dr. Spring, a distinguished professor of the University of Liège, more than ten years ago, which has not attracted the attention it deserves, and to which I have already alluded in my work *Köhlerglaube und Wissenschaft*. On the banks of the Meuse, near Chauvaux, about one hundred feet above the present level of the river, there was a small grotto, or fissure, with two ossiferous beds, separated from each other by stalagmite. There was first a stratum of decomposed and

almost dissolved small bones, about a decimeter thick. This was covered with a stratum of stalagmite one to two centimeters in thickness; then came a mass of broken bones, near a conglomerate of large pebbles, cemented by stalagmite. The bones showed no trace of having been rolled, but were so much decomposed that they crumbled into pieces. Above these broken bones, the fractured surfaces of which were clean, there was another stalagmite crust, about forty-five centimeters thick, covered by a stratum of loam of variable thickness. Many of the bones, though very friable, had retained nearly all their organic substance; but they were strongly impregnated with carbonate of lime.

Amongst the bones of the upper stratum there were a large number of human intermingled with animal bones. The majority of human bones was found at the entrance to the grotto; shin-bones, thighs, arm-bones, bones of the carpus and tarsus, of fingers, toes, ribs, jaws, and cranial bones, all broken, and a large number of teeth fallen out from their sockets.

"All the long bones," says Spring, "were broken either in the middle or at the ends; the lower jaws were more abundant than any other skull-bones; and I possess a piece, as large as a paving-stone, which contains five human jaws, amongst which there is the jaw of a child from seven to eight years of age, the period of the second dentition.

"I possess many fragments of parietal, temporal, and occipital bones. I saw on the spot the parietal half of an entire skull, but it was impossible to extract it without breaking it up. On account of the extremely fragile nature of these bones, I examined this skull before I ventured to give the first blows. This examination, as well as that of other characteristic bones, convinced me that I had before me a race differing from the present inhabitants of western and central Europe. The race equally differs from the old Germanic as well as from the Celtic races, which I had opportunities of examining in various collections of skulls.

"This skull was very small, both absolutely and in proportion to the development of the jaw; the forehead was flattened,

the nostrils wide, the alveolar arches projecting, the incisors oblique, the facial angle scarcely exceeding 70 deg. I venture to assert that these characters resemble those of the Negro and Indian more than those of any race now inhabiting Europe. To judge from the length of the thigh and the tibia, this must have been a stunted race, perhaps only five feet high, about the height of the Greenlanders and Lapps.

"Amongst this great number of bones, there was not one which could be assigned to an aged or even to a strong muscular individual; all the bones belonged to females, youths, and children."

Spring obtained, also, a parietal bone fractured by some blunt instrument. The instrument which caused the injury was in the same piece of stalagmite; it was a rudely manufactured stone hatchet, without any perforation for a handle; another stone hatchet was also discovered.

The animal bones, which lay about intermixed with the human bones, were in exactly the same condition. All the long bones were broken; but those which contain no marrow were entire. There were many teeth of beasts of prey, some boars'-teeth, but none of deer, or any other ruminant; which is the more remarkable as human teeth, and the long bones of the large ruminants, were very abundant.

Another surprising circumstance is that, with the exception of a fragment of the lower jaw of a sheep or roe, neither cranium, nor horns or antlers of a stag, boar, ox, or aurochs were found. The bones are those of the deer, ox, sheep, roe, boar, dog, fox, marten, and hare; some bones of the ox and stag are so large that they might be assigned to the aurochs and elk. In addition to these bones were found cinders, pieces of charcoal, and small fragments of burnt clay.

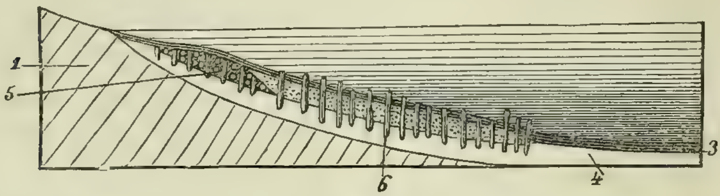
Spring concludes, and, as it appears, with much reason, that the bones of Chauvaux are the remains of a cannibal feast,—an opinion which he founds on the similar condition both of the human and the animal bones, all of which are broken for the sake of the marrow, and upon the circumstance that all human bones belong to young individuals, whose flesh was, no doubt, preferred on such festive occasions. Dr. Spring also quotes

some old authors to show that, in Belgium and Gaul, human sacrifices and cannibalism continued down to the time of the Romans. The short and imperfect description of the skull, though insufficient to indicate the race, gives at least evidence that it differed entirely from the contemporaneous race which inhabited Denmark and North Germany.

Whilst the discovery of Boucher de Perthes, which directed attention to the antiquity of man, slowly made its way, that of Dr. Keller, made at Meilen, near Zurich, in 1853 and 1854, burst upon the world like a thunder-clap. The water being very low, this circumstance was taken advantage of to erect some walls for the recovery of a piece of land from the dried up bottom of the lake. There was seen on the surface a yellowish, grey mud, about one to two feet thick; below this, a bed of sandy clay, two to two and a half feet thick, in which were imbedded the heads of piles and a number of stone hatchets, clubs, hammers, and flint implements. Instruments of bone, horn, and wood, rude vessels of unburnt clay, a bead of amber, a bronze clasp, broken hazelnuts, fir branches, and finally the roof of a human skull and several skeletons, were found in this bed, denominated by Keller "the culture-bed." The piles stuck in the old lake bottom, which, like the uppermost stratum, consisted of light coloured letten, but contained no other articles. Keller soon perceived the great importance of his discovery. He saw at once that he had before his eyes a pre-historical building of a people ignorant of the use of metal, and, as regards civilisation, standing in the same scale as the northern stone-people. No sooner did this discovery become known, than similar discoveries were made in Germany, Italy, and France, and we can say that there exists in the plains of Switzerland, between the Jura and the Alps, no lake or peat-bog which does not present traces of such pile-buildings. The zeal with which these investigations were carried on, has brought many a singular phenomenon to light, and whilst the reports of F. Keller, of which the fifth has now appeared, are models of clearness, we may characterise the huge volume of Troyon (*Les Habitations Lacustres*) as a pious novel, resting, like the now favourite

historical novels, upon foundations borrowed from Moses' family chronicle of the Jewish tribes.

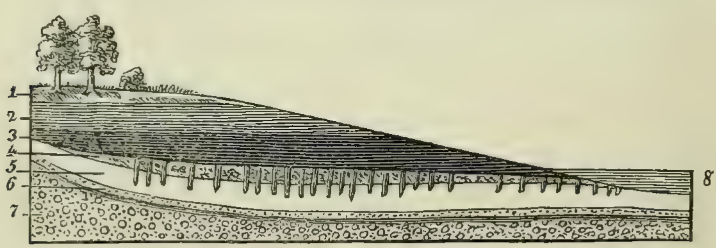
Fig. 105. Section of a Pile-work in the Lake.



1, Rocky bottom. 2. Lake. 3. Mud-bed. 4. Whitish-grey-, or old Mud-bed. 5. Stone-hill of the Stone Period. 6. Culture-bed of the Bronze Period.

Let us return to the facts. There are pile-works situated on the shores of the lakes, at some distance from the water, covered by sand, loam, or calcareous sinter, which have been long known to fishermen, who attached their nets to them. In some few spots the water stands thirty feet above the piles furthest in the lake, but the height of the water is generally much lower. In the lakes of western Switzerland it has been observed that those pile-buildings, in which no metal is found, are nearer the shore and less under water, whilst others, where metal, and specially bronzes are found, are situated at a greater distance as well as greater depth.

Fig. 106. Section of a Pile-Building in a Peat-moss.



1. Vegetable earth. 2. Light peat. 3. Thick peat, with old trees at the bottom. 4. Culture-bed with the piles imbedded in the white bottom. 5. 6. Sand-bed. 7. Coarse gravel, flints. 8. Present lake-level.

The pile-works in the turf-moors are always found in spots, where formerly a lake existed, which even now shows in the middle of the moor traces of its former extension. So it is in Moosseedorf, Wauwyl, Robenhausen on the Pfäffikon lake,

and many other places. There is usually found upon the bottom of the turf-moor, above the gravel and sand of the old alluvium, which in some parts of Switzerland contains bones of the elephant, the so-called white bottom (*blanc fond*), a calcareous bed, consisting of snail-shells reduced to powder, belonging to still existing species. Into this white bottom, which corresponds to the lower letten of Meilen, the piles are driven, and at Wauwyl one pile was found driven ten feet into the old bed of the lake. Upon this white bottom lies the peat generally five to six feet thick, but in some spots it reaches twenty feet. The stone and bone implements of the "culture-bed" usually lie upon the white bottom under the peat, in which no trace of antiquities has been found. The broken bones, the implements, in short, the whole material constituting the culture-bed, form the lowest stratum of the peat bed. If relics of the historical period, such as Roman coins, are found, as at Moosseedorf, they are situated higher up, whilst those of the middle ages lie immediately under the vegetable earth. The pile-works at Wauwyl consisted of five floors formed of superimposed rounded beams connected with the upright piles. The lowest of these floors rests upon the bed of the lake. The thickness of all the layers amounts to about three feet. Two separate platforms are frequently connected by round beams passing from the upper to the lower floor, leaving channels between them. Neither notches, mortises, ligatures, or other contrivances were traced, which would have required more perfect instruments. In some places we are induced to believe that the platform could easily rise and sink with the water. The space between the layers of the trees is filled up with clay and branches. Here and there vertical piles are found, the top of which is burnt in the shape of a cone. Upon this terrain, as far as it has been explored, we are able to trace a rectangular plain 92′ in length and 50′ in width, which seems to have been covered with platforms of different heights. Round this square, which may perhaps be considered as the habitation of a family, are seen frequently irregular vertical piles without any intervening horizontal beams.

These facts enable us to form some definite deduction regarding the age of the pile-works. The alluvial formation in which, in certain Swiss districts, are found the remains of the elephant and the rhinoceros, lies beneath the white bottom into which the piles are driven. It follows, therefore, that the white bottom must have attained a thickness of several feet before the pile-works were erected, inasmuch as the piles are only driven into this layer and not into the gravel. But for the formation of such a lake-bed, consisting of an enormous mass of shells, many centuries were requisite, for we know that though mussels and snails frequently abound in freshwater, still many years are required for the formation even of a thin bed. Thus the settlements in Switzerland are much more recent than the beds of Amiens and the cave beds in which human remains have been found. Nevertheless, they reach back to a remote period, which has no history, the age of which may perhaps be approximatively estimated by the growth of the peat which has overgrown these pile-works. Hitherto we possessed no correct standard for the growth of peat. The calculations hitherto made rest upon no certain foundations, as the upheaving of the peat soil has been erroneously taken for its growth.

The great number of pile-works successively discovered in Switzerland, though they possess many features in common, differ specifically with respect to the metals and other implements found in some of these pile-works. It is undeniable that in East-Switzerland there are numerous pile-works in which none, or but few, metals are found, whilst on the contrary, in West-Switzerland there are many such works which contain objects of the bronze or both periods, whilst in some have been found iron tools, and even Roman coins. To draw, as Troyon has done, a geographical line, is inadmissible, and some settlements afford clear indications that they have been inhabited during the whole period and successively enlarged. Notwithstanding this, we are able to distinguish the stone- from bronze-period buildings, first by their depth, and secondly by the modes in which the piles are worked, independently of the objects found in them. The piles of the stone-period are much

thicker than those of the bronze-period; they are mostly trunks, one foot in diameter, partly incised at the ends, and forcibly broken off; split trunks are rarely found.

The piles of the bronze-period are much thinner, only about four inches thick; the trunks are frequently split into four parts, the tops rise several feet above the ground, whilst those of the stone-period are hidden by the accumulation of stones. As far as I know, there has not been discovered any pile-work overgrown by peat which belongs to the bronze period. Thus, we may distinguish as belonging to the stone-period the pile-works at Moosseedorf, Wauwyl, Meilen, Robenhausen, Wangen, and the numerous settlements on the Lake of Constance. Pile-buildings which continued in unbroken succession from the stone—through the bronze-period, are those at Concise, Stäffis (Estavayer), Hageneck, and some other settlements on the lakes of Bienne and Neufchatel. There are further pile-works which contain iron-tools, like the celebrated Steinberg on the Lake of Bienne. There are also numbers of settlements on the lakes of Geneva and Neufchatel, and also near Sempach, which have only yielded bronzes; and, finally, there is one pile-work which has only furnished iron articles, namely, that of La Têne, near Marin, on the Lake of Neufchatel.

Many of these habitations have undoubtedly been destroyed by fire, as in some places the burnt piles are still found. Messikomer concluded from the direction of the scattered cinders and coals, that at Moosseedorf the fire took place during a violent storm, like the fire of Glarus. In other settlements there was no trace of fire, and when it is considered how easily huts and stores built of wood may burn down, we think archæologists have gone too far when they combine the introduction of metal with the irruption of a new people, and thus explain the burning down of the old habitations. According to Troyon, the pile-works of the stone-period have been partly burnt down by a people coming from the East, who introduced bronze, but have been repaired and inhabited by them until another people, also coming from the East, the Helvetians, arrived with iron swords, who, in their turn, burnt the bronze villages, and also partly re-inhabited them.

M. Troyon seems to have discovered the primitive Orsini shells, clay-balls filled with pitch, which were thrown upon the pile-works. Keller remarks on this point, "It is a pity that when Troyon published his *Habitations Lacustres,* the many lake stations in which Roman implements are found were unknown; he would, doubtless, have proved a third conquest of the country, and a third burning of the pile-buildings, and the decimation of the population as the concluding act of the drama."

On examining such stations as belong to the stone and bronze period, it is found that the stone-period pile-work forms, as it were, the nucleus around which the piles of the bronze period extend and are progressive in depth. There are, according to Desor, piles of the bronze period four to six inches in diameter, thirty feet deep below the mean height of the water level, which are driven in ten feet into the bed of the lake. These piles supported platforms, as at Wauwyl, above the water, and if we assume the height of these platforms at four feet and the imbedding only at six feet, it yields a total length of forty feet for a pile four inches in diameter, which must have been driven in through a depth of thirty feet water. This appears to me no slight task even for an engineer of our own time, but for an architect of the bronze period a manifest impossibility. We conclude hence, that at the period of the erection of the stone piles the waters stood as high as, or even a few feet higher, than at present, but that they gradually retreated, which forced the pile builders to follow the water. It is by this subsidence of the waters that in the smaller lakes many pile-works were exposed, and then abandoned, after which they were overgrown with peat, which must have been rather dry as it contained in its lower strata much wood. The waters rose again at a later period, the pile-works were submerged in the water or buried under the gradually accumulating peat. The surface of the water must have undergone various changes, so that the pile builders were either obliged to follow the water or to settle on the land.

Possibly the first stone-period buildings or stone hills, as they might be called, were only artificial islands, like the so-called

crannags in Ireland, of which we possess a sample in the small lake of Inkwyl, near Solothurn, which were used for fishing and festivals, but rarely for habitations. Some of the pile-works were no doubt inhabited, at least during a certain period; subsequently they were perhaps, as Desor surmises, used as provision stores. Desor remarks: "It is only necessary to look at the objects found in any station to be convinced that they have not been wilfully thrown into the water. Pots filled with provisions are found in some spots, which have neither fallen in accidentally, nor come there in consequence of an attack on the proprietors, for in the latter case we should find some human remains. The bronze articles are nearly new, the pots entire, the provisions well arranged, and according to the opinion of experienced explorers, a rich booty is only obtained where the piles are burnt. These places were thus probably magazines which were burnt accidentally; and the habitations constructed of brushwood and clay, one of which was found on the Ebersberg near Zurich, were in the vicinity of the land."

I must confess, gentlemen, that since I have visited the North, this view seems to me much more probable than the habitation theory. In the North, the water is the high way. The populations dwelling on the Fjords hold intercourse by way of water, the stores stand upon piles, and the merchandise is transferred to the boats and ships from these stores. The fishermen and the Lapps, who frequently come from a considerable distance, cook, eat, and sleep upon the wooden piers which surround these stores. It is not improbable that, at the earliest period, the conditions were similar in Switzerland. Most of the roads along the lakes have only been made very recently, so that even down to our own century the inhabitants of the shores could only hold communication by means of boats.

It is very possible to trace in the industry and the whole condition of these pile populations a progressive civilisation. Thus the implements on the lake of Constance are very rude and clumsy in shape, whilst some of the objects of Concise will bear comparison with some of the best finished articles

found in the north. Concise also shows a greater richness in domestic animals, specially a peculiar stock of cow, which has not been found in the east. An antiquary once told me, that the inhabitants of one district were probably peasants, whilst the others belonged to an industrial aristocracy. This difference may depend either on the locality or on the periods, which are, however, not distinctly separate, but merely indicate slow and progressive civilisation. Notwithstanding the scantiness of the materials, it must be admitted that culture had attained a certain development, bearing testimony to the acuteness, energy, and endurance of this primitive people. They knew how to work the stone without metal tools, and to use it according to its nature for different purposes. Thus the harder molasse served for whetstones and handmills; the serpentine, for hammers and hatchets. The hard pebbles served for cutting tools. Several kinds of stones were imported from a distance, flints from the chalk beds of France, perhaps also nephrite from the East. With regard to this substance, which is but rarely met with in Switzerland, there prevail great doubts. Though nephrite is now imported from the East, it is not known in what part it is most abundant. It is, moreover, by no means certain whether the hatchets made, according to antiquaries, of nephrite, are really constructed of this mineral, and not rather of an exceptionally hard serpentine, or a tough felspar, which Saussure formerly called jade. It is also possible that, in the conglomerates which contain so many stones foreign to the north side of the Alps (as, for instance, porphyry), this material of Swiss so-called nephrite-hatchets may yet be found. It is very desirable that all minerals used by the pile builders should be more carefully studied than they hitherto have been. An analysis of this kind has taught us the mode by which the erratic blocks have been carried by the glaciers down into the valleys, and in this way we may obtain some clue as to the mode in which the pile builders communicated with other peoples.

It belongs to a special branch of archæology to trace the mode of working the mineral; how it was fastened to a handle of wood or staghorn, how the wood was split and carved, how the

bones were fashioned into arrow-heads, needles, hooks; how the teeth were perforated to serve as ornaments. It is of particular interest for us to know that the pile-builders were not only cattle-breeders, and had domesticated several races, but became also in process of time agriculturists. The chase was, no doubt, at first, the principal means of obtaining food, but gradually vegetable food supplanted a purely animal diet. I shall quote the remarks of Professor Heer, in every respect a competent judge, on the agriculture of our pile-builders, as published in Keller's report, and also Rütimeyer's investigations concerning the domestic animals.

"Wheat is most common, having been found at Meilen, Moosseedorf, and Wangen; in the latter place many whole ears were found, as well as heaps of grain. The grains are free from husk, and of the same form and size as our present wheat. Ears of the six-rowed barley *(Hordeum hexastichon)*, differing from common barley *(Hordeum vulgare, W.)* by the number of rows and smaller size of the grains, were numerous. According to Alph. de Candolle, the six-rowed barley was the species most cultivated in antiquity (by the Egyptians, Greeks, and Romans). In the ears of Wangen, the longest and best preserved ear has ten to eleven grains in a row. The grains are smaller, shorter, and nearer to each other than that now grown. They are (without the husk) two-and-a-half lines long, and scarcely one-and-a-half line broad, whilst that now grown has grains of a length of three lines, and has almost the same breadth.

"The cereals were probably kept in large clay vessels, of which many fragments are found. These buildings were probably destroyed by fire, so that the cereals became carbonised, which conduced to their preservation in the wet mud. All the cereals of that remote period are in a carbonised state, and, when cleaned from the mud, present a shining black colour. We thus perceive that the above cereals have been cultivated in our country much earlier than has been generally supposed. It is, moreover, known how the cereals were prepared for alimentation. As these peoples had no mills, they used round smoothed stones, between which the corn was crushed, hence

these stones are called corn-crushers. They are found in large quantities in almost all lake villages. The grains were probably first roasted, then crushed, and put into pots, after which the mass was moistened, and then eaten. This mode of preparing cereals was found in use among the natives of the Canary Islands at the time of the Spanish conquest. The Spaniards adopted and have preserved it to this day. The grain is first roasted in ovens, then crushed, and kept in goat-skins. This *gofio,* as the prepared meal is called, still constitutes the bread of the common people of the Canaries, and may be considered as the oldest mode of preparing cereals. Hence, amongst ancient peoples roasted barley is a sacred cereal, which plays an important part in all sacrifices.

" The rearing of plants pre-supposes the cultivation of the soil; how this was effected is unknown to us, as no agricultural implements have been found in the oldest settlements. Crooked tree-branches were probably used as ploughs; how the cattle were fed we know not.

" Horticulture reaches as far back as agriculture. Carbonised apples and pears were found; they are cut into two, rarely into four slices, manifestly to serve as a provision in winter. The pears found in Wangen are a kind of forest pears, called 'achras,' and of small size. Apples are much more common not only in Wangen, but in Robenhausen, on the Pfäffiken Lake, and at Concise, on the Neufchatel Lake. They all agree in size and form, are perfectly round, with large cores and long stalks, which were not found attached to the apples, but near them. Several kinds of apples grow in our forests which agree with the smallest sorts found in the pile-works. Whether these trees were at that period cultivated, or whether the fruit was gathered from the forest trees, cannot easily be determined."

Professor Heer is inclined to adopt the former view, because among the trunks intended to be cut for blocks there were some of apple trees. We should consider this as a proof to the contrary, inasmuch as a tree cultivated for the fruit it bears is not used for other purposes. Professor Heer is further of opinion that the cereals and the fruit trees have been obtained from an Asiatic people, and that the fruits had degenerated

in our forests. It appears to me that the experiments made by Faber to transform a species of grass (*Ægilops*) into wheat sufficiently indicate that cereals may easily have originated in our country, instead of having been imported from Asia. All deductions as to the importation of cereals and fruit from Asia are made from what happened at later periods, when, no doubt, the better species, but not the originals of these cultivated plants were introduced. If indeed cereals, and apples and pears, had been imported from Asia, we cannot understand why hemp and the vine, which certainly are natives of Asia Minor, were not introduced at the same time. A stimulating and intoxicating fruit like the grape would certainly have been preferred to crab-apples. "Stones of the wild plum and *Prunus padus*," continues Heer, "seeds of raspberries and blackberries, shells of hazel and beech nuts, are met with in abundance in the mud, showing that these forest fruits served as food. The aliment of these peoples thus consisted of cereals, fruit, fish, game, and domestic animals; and, no doubt, the milk of the latter was also made use of. The cheese obtained from the milk was probably put into pots, and placed in a chimney-flue. Pots are found perforated at the bottom: these could not have been used for containing fluids, but were adapted for the preservation of cheese, allowing the whey to escape. In the Swiss cottages the cheese is frequently wrapped up in linen rags, and hung up in the flue to dry; there the pots were used instead of linen. However great the resemblance of the bread of the pile-works to carbonised bread, there would still be some doubts were they not removed by remnants of the bran and the well-preserved wheat grains in the pieces. The bran was not removed, and the grains but imperfectly crushed. The whole mass was probably kneaded, and baked between heated stones. Judging from the crust, the bread had probably a disc-shape; it had small pores much smaller than in our wheaten bread, reminding us of rye bread; but no rye has as yet been found in the pile-works, nor did the people understand how to make the dough rise."

Finally, the pile-builders cultivated to a great extent the short flax still grown in North-western Switzerland, and

manufactured of it not only thread, lines, and ropes, but by means, probably, of a very simple loom, various textures, as well as mattings. Hemp was unknown to them, another proof against the introduction of cultivated plants from the East. They may have used skins, but the preparation of leather seems to have been unknown, as but few badly-preserved pieces are found in the pile-buildings. Boats made from single large trunks prove that they navigated the rivers and lakes, whilst the position of the pile-buildings on the lakes shows that they were acquainted with the prevailing winds.

That the introduction of metals, though it took place very gradually, must have been productive of an essential progress in civilisation is clear enough. But what has been stated concerning the stone-period shows that we have to do with a race capable of every mental effort—a race which effected with small means all that acuteness, patience, and industry could effect. The analysis of the remains of a skull of Meilen, the only one found in a pile-work belonging to the stone-period, confirms this view. The piece consists of the roof of the cranium, the frontal bone, the parietal bone, the occipital squama, and a fragment of the temporal bone; the lower part of the skull and face and all the facial bones are wanting. The dimensions of the parts agree exactly with those of the present Swiss skull of a youth; it belongs evidently to the same stock and the same race. It is also remarkable that this cranial type persists through all subsequent periods, though other cranial types from the pre-Roman period down to the middle ages and the present time coalesce with it.

No trace of a copper age, which, according to some archæologists, always precedes that of bronze, has hitherto been found in Switzerland. The copper for Swiss bronzes has undoubtedly been obtained from Alpine copper-ore, that is to say, on the spot, as, according to Fellenberg's researches, it contains nickel, which always occurs in these ores, but is absent in northern bronzes. Since in eastern Europe, especially in the Lower Danube districts, copper implements abound, the bronze cannot have been imported from the East, otherwise copper would also have been imported; nor would

they have fetched tin from foreign parts for the purpose of alloying it with copper. The alloy with tin, and the discovery of pieces of chemically pure tin, indicate rather Belgium and Cornwall as the countries where bronze was invented.

Fig. 107. Skull of Meilen, top view, after a drawing by Professor His.

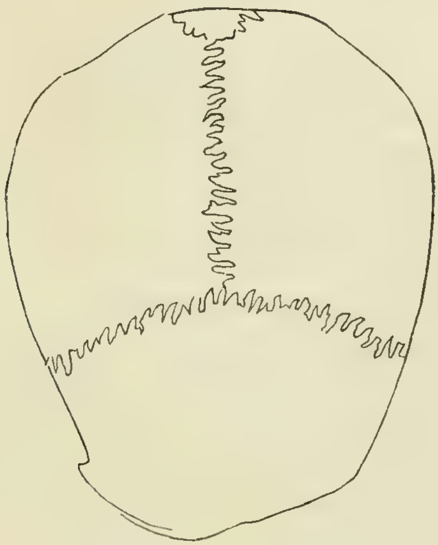
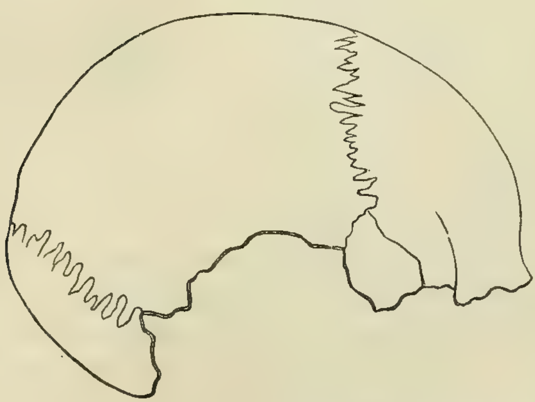


Fig. 108. The same Skull in Profile.



Since the discovery of pile-works in Switzerland many similar discoveries have been made in other parts.

I consider those found in Italy to possess peculiar interest.

Those discovered by Gastaldi and Strobel testify that also in the ancient district of civilisation there existed in pre-historical times a stone and a bronze period, of which the oldest Italian authors and the Romans had not the least idea. My friend Desor justly observes, that garrulous Pliny, who had a villa on the Lake of Como in the immediate vicinity of such pile-works, would certainly have noticed them had any tradition respecting them existed among the people. But every trace of such a tradition had already disappeared when the Etruscan pre-Roman civilisation unfolded its blossoms in Italy. I regret that I cannot enter into further particulars with regard to Italian researches, which have furnished us with relics and skulls from the stone and bronze periods, and well deserve an attentive study.

Attempts have been made to determine the period in which the pile-works of the stone period have been erected; but, as we have already observed, it is impossible to find in tradition and legend any starting points leading to historical dates. It is, therefore, only feasible to proceed as in geology, namely, by taking into account the relative position of the strata. Whilst in historical chronology years, months, and days are to be determined, geological chronology lays no claim to such exactness, as it embraces periods of time in which such dates are mere vanishing points. Still, attempts of this kind deserve acknowledgment, though they repose upon a fluctuating basis, and yield results which cannot be determined exactly within thousands of years.

Morlot was the first who made such an attempt. In the vicinity of Villeneuve, on the lake of Geneva, the mound formed by a torrent, *la Tinière,* was opened in a railway cutting one thousand feet in length and thirty-two and a half feet deep. The internal structure was thus laid bare, and appeared perfectly regular. In the centre lie large rolled blocks, some as much as three feet in diameter; on both sides the alluvial material becomes thinner and finer. Three layers of vegetable soil were cut through at different depths, which must at one time have formed the surface of the cone; they were interposed at regular intervals, between the alluvium, parallel to each other and the present surface of the cone.

The upper layer was 4—6 inches thick, and about four feet below the present surface; in it were found angular pieces of Roman tiles, and an obliterated Roman bronze coin.

The second layer was six inches thick, and lay at a depth of ten feet; it contained some fragments of unvarnished clay mixed with sand and a tweezer made of bronze.

The lowest layer was about 6—7 inches thick, at a depth of nineteen feet. In it were rude pottery, pieces of charcoal, broken animal bones, a collection which indicates the stone period, though certainly the end of it, as Rütimeyer, after an examination of the bones, believes that they belong to a later period than the stone epoch. "Besides numerous remains of man," says Rütimeyer, "there were some of the domesticated dog, pig, sheep, and cow, perfectly resembling the present species, but differing widely from those of the stone period. It was not merely the recent aspect of these bones, but the great difference between these races of dogs and swine and those of the pile-works, which testifies that these bones are later additions to the relics of primitive human industry." No stone or horn implements were found, which might have thrown some light on this point.

Morlot's calculation is founded on the regularity of the structure of the above cone, and the uniformity of its growth. The Romans, he observes, came into the country fifty-eight years before Christ, after the battle of Bibracte. In the year 563, after Christ, Tauredunum was destroyed by the fall of a mountain, and already, a century before, the Burgundians, who did not burn their bricks, had put an end to Roman dominion. The Roman layer is, therefore, at the utmost eighteen centuries, and at least thirteen centuries old. Assuming now that the torrent had since that time deposited about four feet (1,14 meter), and that this accumulation proceeded from the remotest time at a uniform rate, we obtain for the bronze-bed an antiquity of at least twenty-nine, and at most of forty-two centuries; for the stone period, a period of at least forty-seven, and at most seventy centuries; and for the whole cone, about one hundred centuries.

I must here observe, that in the layer of the stone period

a human skeleton was found, with a very small, thick, and round skull, which, from the measurements of a M. Montagne, is said to have presented the type of a brachycephalic Mongol skull. I have, unfortunately, been unable to learn anything of the fate of this skull, and as far as I know, my colleagues His and Rütimeyer are equally in the dark on this subject.

Pruner-Bey lately published in the bulletins of the Paris Anthropological Society some details concerning this skull, apparently in his possession, which I must notice here.

"The skull," says Pruner-Bey, "measures 129 millimeters in length, the thickest part of the roof measuring 12 millimeters in diameter; the forehead is absent, it flies off behind the orbital arches, which are much developed, as in the ape. As the superior orbital ridge is quite straight, we may conclude that the external angle of the eyelids was drawn up as in the Chinese. Orbits very wide; frontal bones very narrow; nasal bones projecting; superior jaw drawn forward; surface of the molars flattened by wear; large and wide *foramen magnum* placed much forward; flattened articular head; auditory meatus of fair diameter; nasal fossæ very thick; occipital squama rounded with very projecting ridges for the attachment of muscles; cerebellar cavities very broad and deep.

"*Remark.* Sight and smell seem to have been powerfully developed in this individual; and if the cerebellum be connected with muscular activity, he must have been very nimble. . . .

"This shortheaded type is even at present found among the populations inhabiting the banks of the Lake of Geneva and the Rhone, and Von Baer found it very prevalent among the population of the Grisons. There we come to ancient Rhætia, which leads by the gorges and southern declivities of the Alps down to Etruria."

I have cited this note in order to show how little science is served by such descriptions. There is, in fact, here not a single character applicable in any way to those Helvetian skulls known to us as decided types of brachycephaly. Unless there be a misprint in the longitudinal measure, the skull measured by Pruner-Bey must be that of an idiot or a child,

for all skulls measured by Von Baer and myself have a longitudinal diameter of at least 170 millimeters. In all the Romanic (Helvetian) skulls I have seen, amounting to several hundreds, the forehead rises almost perpendicularly, whilst the supraciliary arches are scarcely developed, and the frontal bone is at least in the posterior region very wide, and presents only, as Von Baer remarks, a local constriction behind the eyes. The occipital squama descends also almost perpendicularly, its muscle ridges are but little developed, and the *foramen magnum* is, on the contrary, placed farther back, whilst the articular surfaces are much projecting. This backward position of the *foramen magnum* is so great that Von Baer considers it as a decided approach to the animal form.

The notice of Pruner-Bey does not even afford a certain indication whether the said skull, from the alluvial cone of the Tinière, near Villeneuve, is really a short head, as the transverse diameter is not mentioned at all. But all the other characters are so opposed to those of the well-known Romanic (Helvetian) skulls, that I must decidedly reject Pruner-Bey's unfounded inferences as to their supposed similarity.

I must here add, that in other passages Pruner-Bey compares a Helvetian skull to that of Meilen, which, as we have seen, has nothing in common with the Romanic cranial type. I very much doubt whether by this Helvetian cranium he meant that of Tinière, for there the following measurements are given for this Helvetian skull:—Length, 195 millimetres; width, 145; which would give for the head-measure 74·3, corresponding to that of what we have termed "apostle-heads." It is indeed difficult for an unprejudiced person to find the guiding thread in this Pruner-Beyish labyrinth.

Such calculations are open to various objections. Despite of all apparent regularity, the deposits of a mountain torrent are never quite regular. One single flood, in consequence of a storm, may bring more material than will be deposited regularly in long periods, and this material will be deposited according to its gravity on the sides as regularly as that gradually accumulating. The computation as regards the Roman bed, which forms the basis of the whole calculation, is as ques-

tionable as that of the stone-period, the bones of which are certainly of a more recent date.

Gilliéron, who discovered in the vicinity of the Zihl-bridge, near Neufchâtel, a pile-work of the stone-period, arrived at similar results. The "culture bed" has a thickness of at least five feet, and lies below a layer of black mud, above which is a bed of loam about five and a half feet thick, in which many freshwater snails are found. The pile-work, which is visible in the Zihl when the water is very low, was in the vicinity of the spot where the former connection between the Neufchâtel and Biel Lake is narrowest, and amounts to at most 400 metres. The lakes, according to Gilliéron, retreated slowly, and the intervening space through which now the Zihl flows was gradually filled up by moss and peat.

This retreat, no doubt, took place very slowly, as the fine alluvial mud is everywhere regularly levelled and stratified. If now we were enabled to find an historical standard of this retreat, it might be applied to the whole distance from the pile work to the Biel Lake, a distance of 12,800 Swiss feet, which Gilliéron only estimates at three kilometres. But in the vicinity of the Biel Lake (Lake of Bienne) was built the old Abbey of St. John between 1090 and 1106, so we may assume the date 1100. A document, prepared a century later, grants to the convent the right of fishery from the poplars growing on the shore of the lake, but which poplars no longer exist. At present the convent is 375 metres distant from the shore. Gilliéron now assumes that the Abbey was built near the water, and that this distance affords a measure for the alluvia accumulated within 750 years. For greater certainty, he does not measure the distance from the convent to the pile-work, but to the point from which the lake regularly retreated, and, assuming the distance to be 3,000 metres, he calculates that 6,000 years at least were required for the retreat of the lake.

I say *at least* 6,000 years, for the assumption that the convent was built on the margin of the lake is incorrect, but that the convent people built at some distance from the lake, and that the poplars, though nearer the water, were also planted

at some distance as a protection against the north-east wind, which throws the waves far up the shore. But if the basis upon which the computation rests becomes narrower, by the assumption that convent and poplars stood at some distance from the water, the time which the lake required to retreat is increased in an inverse ratio. Assuming that the poplars stood at the edge of the water, about 100 meters from the convent, the lake was within seven centuries only filled up 275 meters, and required 8,000 years for its retreat; and, assuming 200 metres distance between the poplars and the convent, which might be supported by the mention made of the poplars in the document on fishing, which poplars stood at some distance, we obtain 13,000 years for the retreat of the lake. At all events, the assumption of the least of the above periods again shows that the Biblical Adam and his chronology falls, between the piles, into the water.

An attempt to save the chronology must be made, and pious M. Troyon does not shrink from attempting it. In the vicinity of Yverdun is seen, in the middle of the peat, a rocky island about 400 feet high, called the Chamblon, at the foot of which, about eight to ten feet below the peat, was discovered a pile-work with stone hatchets. The distance between the pile-work and the lake is, according to Troyon, 5,500 feet. Yverdun, the Roman Eburodunum, is built upon a dune extending over the turf. According to Troyon, the lake is said in the Roman period to have washed the town; at present it is 2,500 feet distant from it. A simple comparison shows that if the lake has in 1,500 years retired 2,400 feet, it must have required 3,300 years to retire from the pile work, and so Biblical chronology is saved.

Unfortunately there are also sceptics in the faithful Canton of Vaud, and a M. Jayet, who for many years has inhabited and explored the above district, finds but little difficulty in upsetting the whole of this orthodox computation.

"The peat in the vicinity of Chamblon," says Jayet, "presents a rare peculiarity; it is divided into two layers, which are separated by a thick stratum of mud, evidently deposited by the lake. The piles found in the upper peat layer are em-

bedded in this mud. The pile-works thus belong to an older period than the upper peat, and to a later period than the lower peat with its mud covering. It is just this lower peat bed which is connected with the lake formations of the plains.

"If, then, the calculation of M. Troyon be correct, both the formations which he compares should be of the same kind, which is not the case. Nothing is more simple than the formation of the sandy alluvia between Yverdun and the lake, which are formed by the sand brought by the streamlets to the lake, and which the billows cast upon the low banks; nothing, on the other hand, is more complicated than the plain between Chamblon and the lake. To the alluvia which first raised and filled the bed of the lake, three successively formed dunes, and two peat beds, have been added, which are separated from each other by a layer of mud. This complicated stratification required a much longer time, and the thirty-three centuries of M. Troyon are quite inadequate for the chronology of the pile works."

I must here add, that the calculations of Troyon and Gilliéron are founded upon an erroneous basis. It is impossible to calculate the time of the retreat from the horizontal distance; it is the vertical distance which is to be attended to. Let us imagine a flat lake-basin a few kilometers in length, gradually drying up. Around this lake are certain structures. The surface of the water having sunk two feet, a space one kilometer in diameter is dried up at one end. A structure is now raised near the present water level. The lake sinks again two feet, and in one thousand years the last structure is a kilometer from the shore. But the lake-basin is narrow; and of the older structures, situated two feet higher, it would only be the most distant which would furnish a correct result in calculating its age—all others would yield a false date, as they lie 800, 600, or perhaps only 100 meters in a horizontal distance from the recent structures. Gilliéron would thus obtain a different result were he to found his calculation upon the nearer Neufchâtel lake, and Troyon would, for a pile-work on the southern bank of Chamblon, instead of the northern, have

obtained a result which would have thrown the age of this second pile-work far beyond the time of the Biblical Adam.

The only trustworthy basis for computation, is the *vertical increase of the peat* in the districts where pile-works are buried in the peat. For this we have at present unfortunately no starting points ; my inquiries on this point of many naturalists have not yielded any important fact in this respect.

I cannot, however, leave this subject without presenting you with a short summary of the absurdities in which man becomes entangled when he attempts to force the facts furnished by nature into the narrow frame of the Jewish family chronicle. I take the book of Troyon (*Les Habitations Lacustres*), and summarise thus. After the deluge, the peoples of Asia commence their march to populate the whole earth. No doubt, the art of building upon the water was first invented in the dry highlands of Asia. The first settlers, the post-diluvial squatters, sprung from the blood of Japhet, naturally march along river-valleys and the coasts. They bring with them large herds of domesticated animals. The travellers on the coast are frequently stopped by the mouths of the rivers; the travellers in the valleys are delayed by marshes or rocks. The land must be explored, and the domesticated animals must be protected from the wild beasts.* They therefere made themselves rafts for protection.† Such a raft having been built, it is not readily abandoned, as it forms a refuge for the old and young. They have, therefore, rafts which are fixed when they have a stoppage. "From rafts," says Saint Troyon, "to ship-building is certainly a wide leap; but the old tradition of the deluge, and the ark of Noah which floated upon the waters, had been preserved, and this tradition gave hints as to the fastening of the trunks requisite for constructing a raft. If a family abandoned a migratory life, the raft acquired the character of a permanent habitation. But where the waves proved too strong, the people naturally hit upon the idea of changing the

* That these wild beasts, which also came from the ark of Noah, should have spread more rapidly than privileged man, and should have threatened him in his resting places, I cannot well understand.—C. V.

† How could these rafts protect them from the ice-bears and phocæ, which are excellent swimmers, and were also in the ark of Noah.—C. V.

raft into a platform raised on piles above the water, so that the billows could not reach it, and this is the origin of the pile-works."

Thus the squatters travel leisurely from east to west, from Asia to Europe, along the coasts and up the rivers. It is, however, thinks Troyon, difficult to say whether the first inhabitants of Switzerland ascended the Rhone or passed over the Rhine. We much fear that this question will remain unsolved, but we should like to know how these clumsy rafts could have ascended a river, which feat, between Seyssel and Geneva, cannot be effected by steamers. But as faith removes mountains, rafts can no doubt ascend the Rhone.

There is another hard nut for Bible believers to crack, namely the knowledge of metals. The stone people of Europe knew of no metal. But Tubalcain, the Biblical Vulcan, was an artificer in brass and iron before the Mosaic deluge, and as, according to the sage remark of Troyon, man must acquire by labour all that is requisite for his comfort, he cannot have commenced with being a blacksmith. "But," continues M. Troyon, "we need only imagine these first migrations towards the West, to comprehend how a people can lose the knowledge of metals. There is no doubt that these families, at their departure from Asia, possessed metallic instruments, but their nomadic life did not permit them to work mines, to establish forges, or to acquire the social organisation requisite for different handicrafts. The further these families penetrated into unknown regions, the ways behind them were cut off, and they were no longer able to communicate with the centres of Oriental civilisation." Thus the poor people necessarily forgot the working of metal and had recourse to stones.

At a later period came the Bronze people, also from Asia, and killed their unfortunate predecessors, burnt their huts, and established themselves, worshipping the moon. There were discovered some pieces of clay or stone in the form of a crescent belonging to the Bronze period; these, it was said, indicated moon worship. These things were perhaps only head-pillows, for many people even now use a crescent-shaped block of wood or stone for a pillow.

But the Bronze people* were also punished for their forgetfulness. Tubal-Cain was an artificer in brass and iron, and the Hebrew word "Barsal" in Genesis means iron, and no other metal. Thus Noah's brother, and the whole family of Noah, were acquainted with brass (bronze) and iron. The Stone people forgot during their migrations both metals, and used horn and stone. They kept their nephrite hatchets, but threw away their bronze knives and iron hatchets, and forgot their use. The Bronze people kept their bronze knives, but cast away the iron tools and forgot their use. That was a great misfortune; for, after having long dwelt in the habitations of their forgetful Stone brothers, the vengeance of God came over them, for the bigheaded Helvetians, also from Asia, came over them, slew them, and burnt them out.

O sancta simplicitas!

* It is scarcely necessary to remind the reader that bronze-people, stone-people, stone-skulls, are mere abbreviations for peoples and skulls belonging to the bronze or stone period.—Editor.

LECTURE XIII.

Distinctive Characters of the Cavern- and Stone-Period. Skulls of Denmark.—Arching of the Forehead.—Apostle-Skulls of Switzerland, and their Age.—The Jaw of Moulin-Quignon.—Skulls of Lombrive compared with those of the present Basques.—Danish Stone-Skulls compared with the present Lapps.—Skull of Meilen.—Relation to the present Swiss Skulls.—Romanic Short-Heads.—Relation to the Etruscans.—The Oldest Domestic Animals.—The Dog.—Swine.—Wild Hog, and Marsh-Hog.—Horned Cattle: Urus, Wisent, long-fronted, and curved-horned Cattle.—The Sheep.—The Goat.—The Horse.—Cultivated Plants.

Gentlemen,—We considered in a preceding Lecture the conditions under which the primitive man existed in Europe. In arriving at the conclusion that he co-existed with the extinct animals of the so-called diluvial period, reaching far beyond any historical data, we, at the same time, obtained the result, at least as regards the oldest skulls, that such cranial formations as those of Engis and the Neanderthal, are at present no longer met with in European races. A cursory comparison of later skulls of the South of France, and of the sepulchres of the stone period of Denmark, equally showed that those parts must have been inhabited by other races, whose cranial formation differs so much from those first mentioned, that a descent in the direct line is hardly conceivable. We intend to-day to pursue this inquiry, and endeavour to trace the connection of these various phenomena, aided by an examination of domestic animals and their development.

I have already observed that the distinguishing character of the two cave-skulls lies in the extraordinary length of the whole skull, in the comparatively small width which falls behind the region of the parietal prominences, and in the peculiarly attached occiput, which in one of these skulls, viewed from above, presents almost a straight line of the lambdoidal suture, whilst, in the other, this line presents the

usual triangular form. A minute examination of the two skulls led me to conclude that they belong to the same race,

Fig. 109. Neander-Skull, top view.

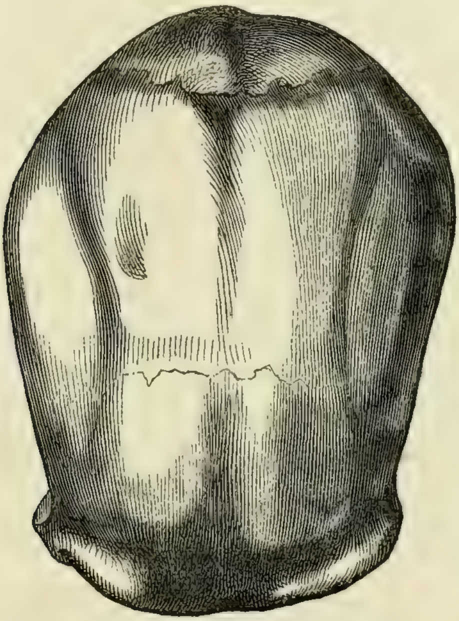
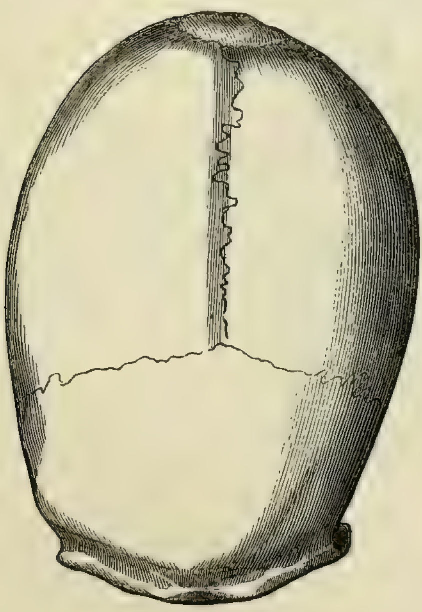


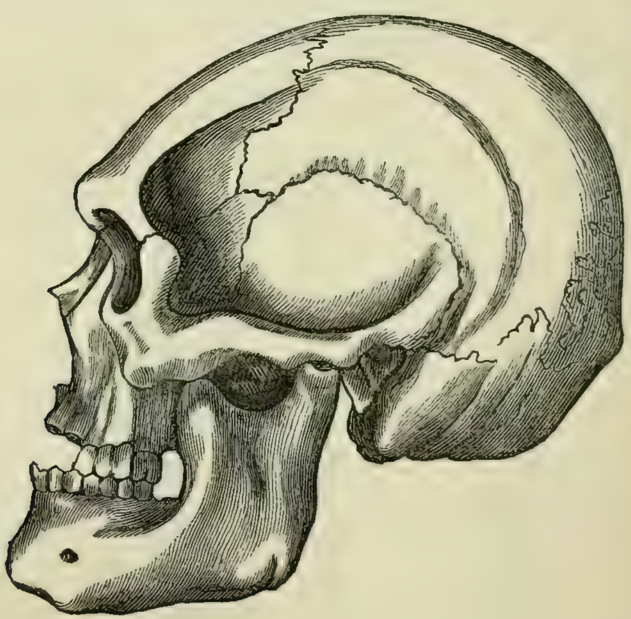
Fig. 110. Engis Skull, top view.



though the development of the supraciliary ridges, and the arching of the cranial roof, seemed to present at the first glance great differences.

With regard to the formation of the supraciliary ridges, the prominence of which, though not always, yet in this case depends on the dimensions of the frontal sinuses; there is no doubt that they are also usually connected with the greater development of the crests, ridges, and muscular force in general, and are thus an attribute of the male sex. Professor Schaaffhausen cites numerous examples which prove that this connection exists both in animals and man. It will be found in living persons that the imperceptible transition of the forehead into the supraorbital margins is chiefly seen in women, whilst the projecting eyebrows, frequently separated from the forehead by a deep groove, is peculiar to muscular males. The same observations may be made on old skulls in which the

Fig. 111. Skull of Borreby, Denmark (Stone-Period), side view, after Busk.



development of the supraorbital prominences greatly differs, though all other characters are perfectly identical. Thus, Professor His, of Basle, communicates to me the interesting

case of two old skulls found in a Waadtland (Vaud) grave, which, as may be inferred from the surrounding bones, belonged the one to a male, the other to a female; the male skull had remarkably prominent supraciliary arches, whilst in the female skull the forehead was quite smooth without prominent ridges.

Mr. Busk has kindly sent me a list of the measurements of twenty Danish skulls of the stone-period, with many other perfectly exact drawings. Proceeding on the principle that the female skull is smaller than the male skulls, I discarded from the list as female skulls all such as exhibited the smallest longitudinal diameter. I now compared the figures, and found that those which I had put aside as female skulls had smooth foreheads, whilst the male skulls possessed prominent supraorbital ridges, some of them to such an extent, that they might be placed side by side with the Neander skull, whilst the skull marked by Busk as a female skull presented no trace of any protuberance, and in the flattening of the supraciliary arches exceeds even the Engis skull. It is, moreever, known that in monkeys, which are distinguished by the size of the supraciliary arches, the latter are only developed with advancing age, which is also the case in man. As now the female skull always preserves a certain amount of the characters of the child, so that the male skull, about puberty, scarcely differs from the adult female skull, this circumstance is equally in favour of my view, according to which the development of the supraciliary arches ought not to be considered as a race,—but as an individual and sexual character. I must, however, qualify this assertion so far, that I do not mean to insist that such an enormous projection of the supraciliary arches as those in the Neander skull can occur in all races. But wherever there exists in any race a tendency to such a projection, it will only be met with in males, and perhaps exceptionally in some masculine women, with a strongly developed muscular system, but not in typical women.

The second essential difference between the Engis and the Neander skull consists in the arching of the forehead and the roof of the cranium. The Neander skull is so flat, that it might belong to an idiot; the Engis skull, on the contrary,

though it presents a low, narrow, and but little capacious forehead, might still, according to Huxley's opinion, have belonged to a naturalist. But on carefully examining the general outline which both skulls show as regards the curvature, we find that it agrees to a considerable extent.

Fig. 112. Neander-Skull.

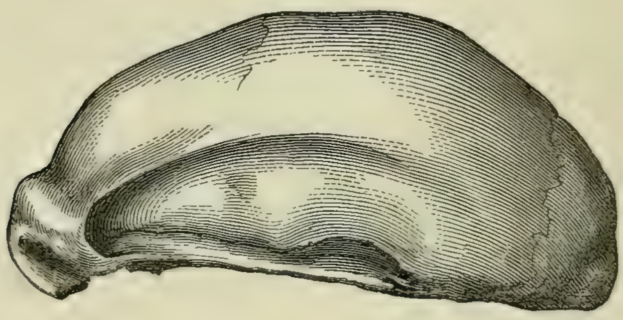
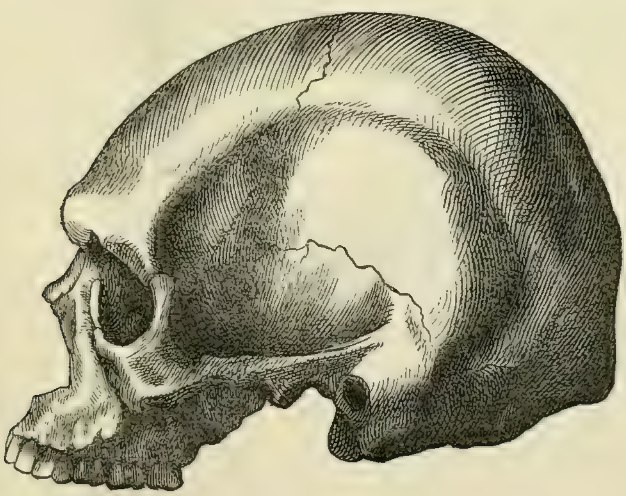


Fig. 113. Engis Skull.

This line ascends gently and uniformly from the frontal prominence to the vertex, which lies further back, nearly above the mastoid process. From this vertical spot the curve descends backwards in the same oblique line. The mode of formation is exactly the same in both, though the height of the arch is much greater in the Engis skull. But these peculiarities find their analogues when we compare larger series of skulls of both sexes belonging to the same race.

Professor Huxley has very justly drawn attention to the fact, that the arching of the forehead and the skull greatly varies in Australians, and it does not appear to me by any means improbable that in the lower races, where the long and flat skull of the adult must be developed out of the roundish and arched skull of the child, the female has a skull higher arched though narrower than that of the male. The drawings of Busk lead to the same result; all the male skulls without exception stand, as regards the arching of the forehead and the skull, far behind the female skulls which come from the same locality and belong to the race of the stone period.

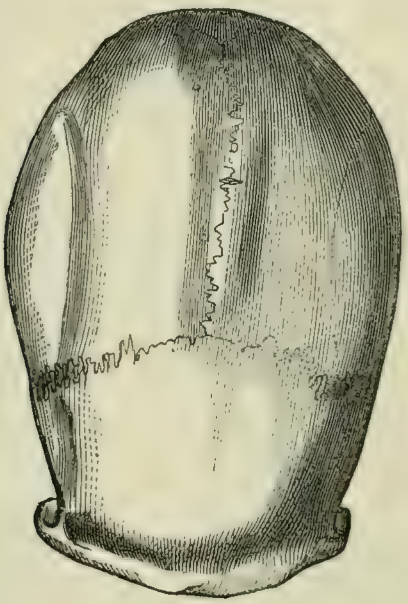
Fig. 114. Skull of an Austral-Negro, after Lucae, side view.



It has been generally asserted that among the present European cranial forms, there was not one which any way approached that of the above cave skulls; and, in point of fact, the Dutch only show a distant approximation, inasmuch as they possess the longest skulls in Europe. I was, therefore, not a little surprised to find, in the Anatomical Museum of Berne, the roof of a cranium, ticketed as having been found near Biel, which Professor Valentin placed at my disposal, and which, on examination, might be pronounced the twin brother of the Neander skull! The projecting supraciliary ridge, the depression in the forehead, the flat ascending arch of the

cranium, the backward vertex, with its steep declivity towards the neck, were all present; the length was nearly the same, the width less, so that this cranium is the smallest known to

Fig. 115. Skull in the Museum of Bern, top view.

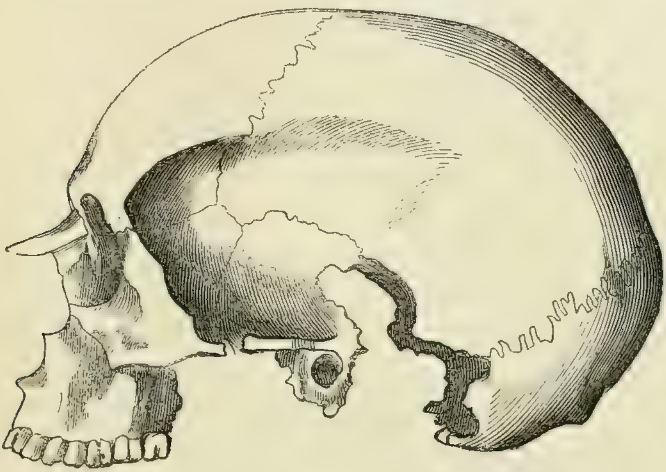


me. Viewed from above, the form is the same, though the bones of the Bernese skull are all smaller and thinner. The anterior frontal prominence is transversely cut off, and the occiput projects in such a manner that we have the figure of a drawn-out pentagon with a posterior rounded apex. It was evident that I had before me the roof of a cranium which belonged to the same race-type, and as regards form and size, was intermediate between the Engis and Neander skull.

You may easily imagine that this circumstance puzzled me not a little, and that I spared no trouble to discover some particulars as to the finding of this skull, which has been for more than thirty years in the collection of the museum. My endeavours were fruitless. The Bernese skull remained a riddle as regards the place of its discovery. The old ticket put upon it, probably by Albrecht Meckel, pointed out its resemblance to the skull of a Dutchman born at Leyden, and delineated by Blumenbach.

On comparing the drawings of many skulls from old graves and pile-works of Switzerland made by Prof. His, we both were struck with the resemblance of some of these long skulls to my Bernese skull.

Fig. 116. Long-Skull of Hohberg, near Solothurn, after a drawing by His.



One of these skulls was in Basle; another had been dug out by Hugi, twenty years ago, in Hohberg, about three miles from Solothurn; a third belonged to the collection of Colonel Schwab in Biel, and was found in a pile-work on the lake.

We had now some starting points for further inquiries. A journey to Biel and Solothurn furnished us with further particulars, and gave us at the same time an opportunity of examining about two dozen old skulls, which Dr. Schild had dug out at Grenchen, and presented by him to the museum of Solothurn, the director of which, Prof. Lang, had the kindness to place them at my disposal. Even among these Swiss skulls of Grenchen, there were, by the side of broad Swiss skulls of the present type, two narrow skulls which I studied.

The archæological question was soon solved by M. Amiet, the learned town clerk of Solothurn. The graves opened by Hugi, in the Hohberg, contained large ear-rings and bracelets of bronze, strings of amber beads, and light blue opaque glass pearls, iron swords, one with a silver ring and an old inscription signifying, according to Professor Mommsen of Zürich,

Renatus. These graves belong, according to Amiet, from their contents, undoubtedly to the end of the Roman period, that is to say, to the end of the fourth or beginning of the fifth century, about which time Christianity was introduced in Switzerland.

A similar ring was found in the graves of Grenchen, which thus belong to the same period.

The skull of Schwab's collection came from a pile-work in the vicinity of the effluence of the Scheuss, from the lake of Bienne, which hitherto has only furnished Roman antiquities.

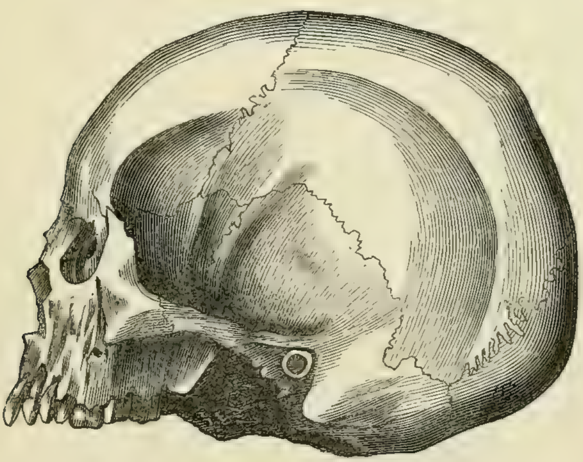
All the narrow skulls of this kind known to me, where the spots where they were found had been well examined, thus belong to the same period,—the period of the decline of the Roman empire and the introduction of Christianity in Switzerland. They are in small proportions mixed with other skulls which, as comparative examination teaches, have preserved their type from a comparatively recent period down to the present day. We are thus permitted to suppose that these narrow skulls which approach the simian type must have belonged to immigrants, who arrived only in small numbers, and whose type was not propagated but soon disappeared. But we can trace no other immigration at that period than that of Christian missionaries who, according to tradition, came principally from Ireland. It is not so very improbable that the new religion, before which the flourishing Roman civilisation relapsed into a state of barbarism, should have been introduced by people in whose skulls the anatomist finds simious characters so well developed, and in which the phrenologist finds the organ of veneration so much enlarged. I shall, in the meanwhile, call these simious narrow skulls of Switzerland "Apostle skulls," as I imagine that in life they must have resembled the type of Peter the Apostle, as represented in Byzantine-Nazarene art.

The jaw of Abbeville, the characters of which we have already described, can in nowise serve for the determination of race characters. The wide open angle formed by its rami, may perhaps indicate prognathism, just as the Engis and Neander skulls probably belonged to a prognathous race, but no certain

inference can be drawn. I have three of the abovementioned "Apostle skulls," found in three different places, before me, whose facial bones are so far preserved that the profile is perfectly recognisable. The arching of the forehead is in the skulls of Biel, Hohberg, and Grenchen considerably greater, and the forehead fuller and more prominent than in the old cave skulls. The insertion of the nose presents a peculiar character, as even in such skulls as have no frontal prominences there is a deep depression in which the nose is almost horizontally inserted. The front teeth are certainly rather oblique, but not so much as to be considered a special deviation from the type of European skulls.

On comparing these skulls with those of the cave of Lombrive, we find the greatest possible difference.

Fig. 117. Skull from the Cave of Lombrive, side view.



The two skulls sent me by Dr. Garrigou are well preserved, partly covered with tufa. The bones of the skulls are remarkably light, dry to the touch, porous, and adhere to the tongue. The smaller skull belongs to a child of about nine years, just on the point of changing the canine and the first molar tooth. The large skull has such graceful outlines, that it probably belonged to a woman. The teeth show that this ancient people suffered as much from toothache as the present generation. Two of the molars were carious, a third had

fallen out, and the socket filled up. The teeth were worn down in the same manner as observed in mummies and other ancient peoples, very much so for an indicated age of about thirty years. In my opinion, this premature decay is probably connected with the use of that coarse bread, which contains a large quantity of stony particles, and which was partaken of by most ancient peoples. The black bread of the Westphalians (pumpernickel) and the flat cakes of the Norwegians seem both the offspring of the bakings of antiquity, the remains of which are found in the Swiss pile-works.

The shape of the crania of Lombrive is on the whole a noble one. The forehead is high, arched, and slides into the nose with a scarcely perceptible projection of the supraciliary arches. The crown of the head is nearly above the auditory aperture.

Fig. 118. Skull of Cave of Lombrive, top view.

The occiput is somewhat protruding. The temporal fossæ are deep in the anterior part, but rather flattened in the posterior region, whilst the temporal line extends further upwards. The facial portion of the skull is very small, the front teeth scarcely diverge outwards, so little, indeed, that most German female skulls would show a more oblique direction. Viewed from above (fig. 118), the skull appears short, oviform, with broad zygomatic arches, and a considerable transverse diameter,

which passes in front of the parietal protuberances, and about the centre of the longitudinal diameter. In point of fact, the proportion of the greatest length to the greatest width in the adult skull is 100 : 77; but in the young skull as 100 : 82·6—a proportion which need not surprise us, as the young skull is much rounder than the adult skull. The adult skull thus presents proportions as in Jewish and Gipsy skulls, which, according to Welcker, are equal in this respect.

On viewing the skull in front, the orbits seem very deep, and the roof so arched that the superior orbital margin presents a sharp edge. The orbits are at the same time wide and almost square, the nasal cavity is narrow and high, the forehead prominent in the centre, but sloping rather abruptly on the sides, so that the vertex has almost the form of a rounded house-roof. Viewed from behind, the skull appears pentagonal, the mastoid processes forming the inferior, the parietal prominences the superior angles, and the sagittal suture a sharp edge.

In the absence of a large collection, it was impossible for me to determine which type these crania most approach. They are, at all events, of such a character that they need not be ashamed to appear amongst those of other Caucasian peoples. In Dr. Broca's opinion, which is, however, founded more on first impression than on minute examination, these skulls resemble most the present Basques, who still inhabit the country in which the cave is situated. But these Basques are just the most remarkable people—islands, if we may use that term—which exist on the earth, differing in every respect from all the surrounding peoples. They possess a language, the analogue of which has only been met with in America. The Basques are as yet an unsolved problem; they cannot possibly have come from Asia.*

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* Since the time Broca favoured me with this communication, he has availed himself of the rare opportunity of examining sixty undoubted Basque skulls, which were, under his own direction, dug out from the churchyard of a Spanish village. This examination, we may say, is a model of an exhaustive treatise.

Not content with the usual division into short, middle, and long heads, Broca interposes two other categories, which we shall term semi-long and semi-short heads. According to this division, the pure long-heads measure

This resemblance, if it should be confirmed, would at any rate furnish us with some clue relative to the age of this Basque stock, which, with its physical constitution, its lan-

at most 75; the head measure of the semi-long is comprised between 75 and 77·77, *i. e.* between six-eighths and seven-ninths; the middle-heads from 77·77, *i. e.* from seven-ninths to eight-tenths; the semi-short heads, between 80 and 83; and finally, the genuine short-heads comprise all measurements exceeding 83. According to this division there would be, among the sixty Basque skulls, nine pure long-heads, twenty semi-longheads, nineteen middle heads, twelve semi-shortheads, but not one genuine shorthead, so that the mean lies in the semi-longheads; and the Basques possess a proportionally longer skull than the present Parisians, whilst the cranial capacity is also greater,—a fact which cannot altogether be connected with the development of intelligence, but is probably the result of racial difference.

Everyone is, of course, at liberty to fix the limits of the various proportions in head measurements according to his pleasure; still it is to be regretted that no agreement exists as to the signification of the various terms. In fact it has come to this, that any person who uses the terms short, middle, and longheads, must be asked in what sense, and according to what author, he wishes these terms to be understood.

Broca, however, advances a step further, and from his measurements, the terminal points of which can be determined with great exactness, he, with Gratiolet, arrives at the conclusion that two types of dolichocephaly must be distinguished: the frontal dolichocephalic, to which belong the German races, and the occipital dolichocephalic, comprising the African and Oceanic Negroes. In other words, in the former, it is the frontal region, and especially the frontal bone; in the latter, it is the occipital region, which is especially lengthened; and in this way conditions the predominance of the longitudinal diameter.

In order to give these proportions a definite term of measurement, Broca connects the auditory apertures by a line which passes over the posterior point of the frontal bone; or, in other words, he draws upon the skull the diagonal circumference of Virchow (see page 62), which has the same direction. This diagonal circumference represents a section which divides the fore from the back skull, which can thus be compared. Broca now finds that although the Basque skulls are longer, wider, and higher, than the Parisians, still the so-parted off foreskull is less developed in the Basques than in the Parisians, so much that even in circumference it is absolutely smaller by six millimetres. From other measurements Broca comes to the conclusion that the dolichocephaly of the Basques rests mainly upon the disproportionate development of the posterior cerebral lobe.

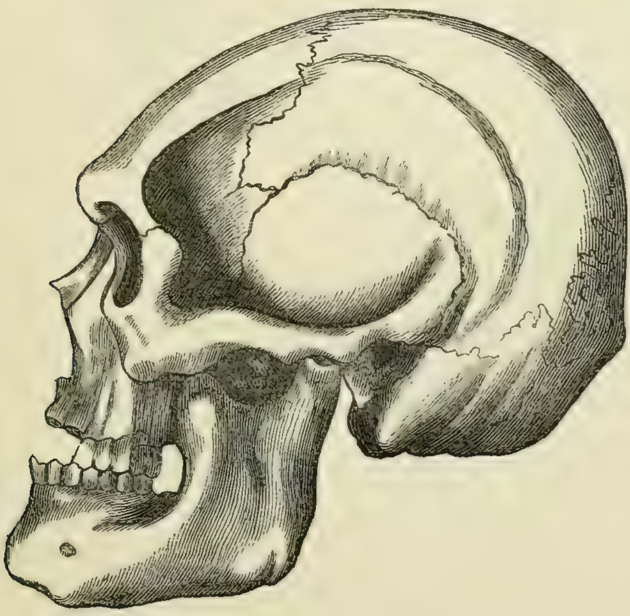
"In proving," continues Broca, "that the Basques present the characters of occipital dolichocephaly, I have, in my opinion, also proved that between them and the Indo-Germanic longheads there obtains a great difference. As among the European races I found no points for comparison, and being reminded that this kind of dolichocephaly belongs essentially to the American race, I studied, by comparison, the cranial forms of the Basques, the Parisians, and the Negroes."

From these comparisons, into the particulars of which we cannot enter, Broca finally concludes:—"The Basques much approach the African longheads; they much resemble the Negroes by the form of the cerebral skull, which in this respect deviates but little from the orthognathous African races.

"I must, however, add that the Basques differ from all African races, even the whitest and most orthognathous, by the smallness of their upper jaw, the slight development of the cerebellar protuberance, and the relative shrinking of the occipital protuberance. These characters equally distinguish the Basques from the European races.

guage foreign to the Indo-Germanic stock, its customs and manners, has been preserved in that corner of the globe which it still inhabits. We are almost tempted to ask whether, instead of that supposed emigration from Asia and Europe to America, we might not rather assume an emigration from America to the Bay of Biscay, perhaps by way of the connecting land between Florida and our own continent, which is now submerged in the sea, but which, according to all probability,

Fig. 119. Skull of Borreby, side view.



was at least in the middle tertiary (miocene) period still above water.

For my own part, I have arrived at the conclusion that the

"I conclude, hence, that in searching for the origin of the Basques out of the Basque country, their ancestors will be found neither among the Celts, nor the rest of the Indo-European nations, but that our investigations must be directed towards Northern Africa. Europe was at a remote period, no doubt, connected with Africa; we need, therefore, not feel surprised to find affinities between the primitive inhabitants of both parts of the world, even if it were not known that many migrations had, in ancient times, taken place across the Straits of Gibraltar."

I would add to this last hypothesis, that the former connexion of the Pillars of Hercules is rendered probable by many facts, among which I may mention the existence of wild monkeys of the same species as those which inhabit, side by side with the Riff pirates, the opposite coast.

skulls of Lombrive belong to a race differing entirely from Belgo-Rhenish cave-skulls. All the characters are so opposed, that a descent of the Lombrive skulls from those of Engis, or any affinity between them, is inadmissible. We do not deny that a long period had elapsed between the time in which the man of Engis and the Neanderthal fought with the cave-bear, to that epoch when the man of Lombrive hunted the reindeer. But, on the other hand, it can scarcely be assumed, that considering these generations of men to have lived in the same conditions, such a period of time should have sufficed to produce such a radically different race.

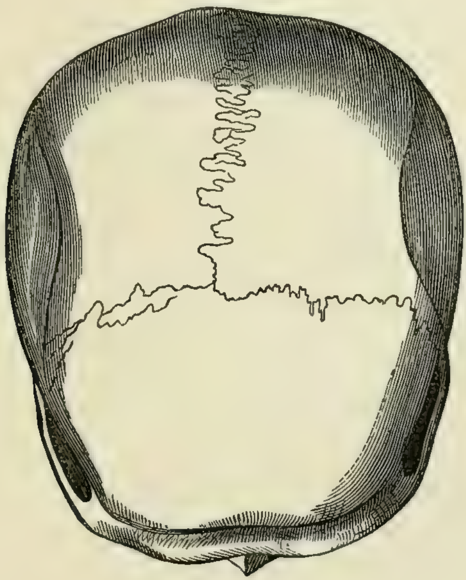
Passing from these skulls to those of the Stone period of Denmark, which appear to me to belong to a later age, I find again a thorough difference in the general characters.

As already stated, Mr. Busk, a distinguished naturalist of London, kindly furnished me with an elaborate table of measurements of twenty skulls, half of this number having been found at Borreby, and the rest in six different places. Seven skulls of Borreby were represented by masterly drawings in the most various aspects, so that I am, as regards the materials, as well provided as is possible in the absence of the originals. The heads are, on the whole, not too small, for their greatest longitudinal diameters vary between 6·58 and 7, 8 English inches, consequently about 171 to 195 millimeters, and at all events the length and breadth of these heads exceed those of the Lapps with which they have been compared. Setting aside those whose longitudinal diameter seems to indicate youth or the female sex (there are six such skulls), we have a series of fourteen adult skulls, the length of which oscillates between 7·2 : 7·8, that is about six-tenths English inches, or fifteen millimeters, namely from 180 to 195. This certainly is an important agreement, which, like the forms of the heads in general, leads to the conclusion that there was a great uniformity in this old stock.

On examining the proportion of length to the width, we find that the oscillation is greater, taking the length at 100, it is 71·8 to 85·7; that is nearly 14 per cent. But, again, setting aside the skulls of the young and the females, of which the

latter occupy the intermediate place and the children possessing the roundest heads the extreme of the series, we obtain the striking result that seven Borreby skulls have a remark-

Fig. 120. Borreby Skull, top view.



able agreement, and represent the widest heads, their measurement being from 80·2 to 82·6, whilst all other skulls found elsewhere measure less, and some even are decided narrow heads. Whether the archæological designation is here in fault, or whether there existed a geographically different stock, cannot be decided from the facts at hand. It is very possible that even at that period there existed in some districts of Denmark a mixture of narrow heads and short heads, as at Meudon, where in an old sepulchre under a dolmen both types were found well represented.

Be this as it may, the skulls of Borreby, which we take as the special types of the Danish skulls of the Stone Period, appear decidedly brachycephalic. Their mean measurement amounts to 81·3, and occupies in Welcker's table an intermediate place between the Germans, Russians, and Turks. The skull is generally well rounded, the forehead rather flat, but not badly developed;

still there are just in this respect considerable differences. The supraciliary ridges are very prominent in the males, and the depression between them and the nose is very deep, as is the groove above the ridges, whilst in the females the forehead seems to slide without any perceptible depression into the rather projecting pug-nose. The greatest elevation of the skull is almost perpendicularly above the external *meatus auditorius*, and viewed in profile the skull is in its posterior part uniformly arched. In but few skulls can there be detected a tendency to prognathism; in most of them the front teeth are perpendicular. Viewed from above, the skulls appear broadly elliptic, the anterior portion being nearly as rounded as the posterior. The greatest width is in the posterior third, about the region of the parietal prominences. The zygomatic arches are short, but curved outwardly. Viewed in front, the forehead appears low but uniformly arched; viewed at the back, the angles of the pentagon seem rounded so as to form a circular line. In fact, no further particulars are requisite to establish that these skulls also present a particular type, that they nowise agree either with the skulls of Lombrive or with those of Engis and the Neanderthal, but that they belong to a separate race, which inhabited Denmark at the remotest period.

The cranial fragment of Meilen, in the Canton of Zürich, is the only human relic from the Swiss stone period possessing any important relation to the determination of race. It is unfortunately so imperfect that it affords no certain index as regards the shape of the skull; still it affords some clue to certain proportions. His, of Basle, describes this fragment as follows: The forehead appears moderately high, finely arched; the supraciliary arch is greatly developed; the semicircular line around the temporal fossa is but faintly marked. The occiput is roundish, but unsymmetrical; of the spine and the ridge of the occipital bone there are only the vestiges; the superior semicircular line is hardly recognisable; downwards it appears as a faint osseous ridge. These conditions do not seem to indicate that the skull belonged to a muscular individual.

The Meilen skull belonged, in fact, to a child apparently

fourteen to sixteen years old. "On account of the apparent obliteration," writes His, "of a portion of the sagittal suture, I was still doubtful, but now I have found that by moistening the skull this obliteration is, indeed, only so in appearance. I

Fig. 121. Skull of Meilen, in Profile, after His.

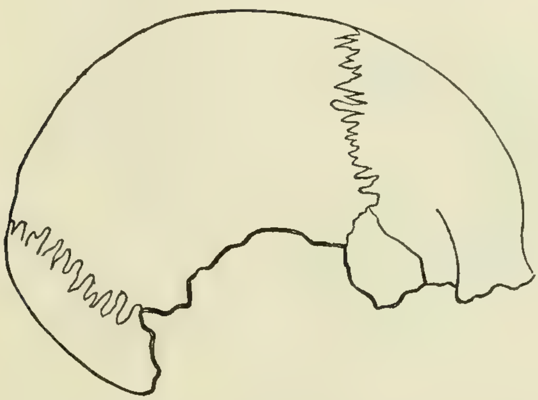
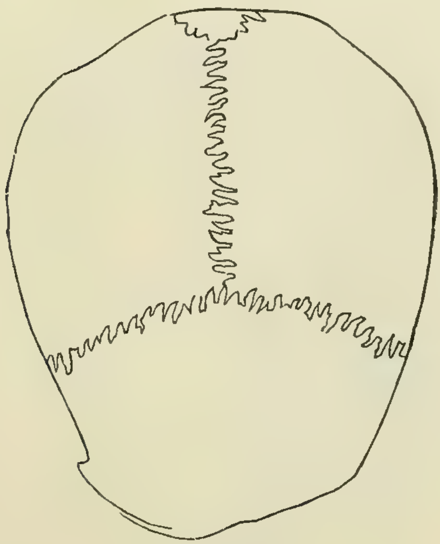


Fig. 122. Skull of Meilen, top view.



have at the same time received from Altdorf the entire skull of a child of our Helvetian (or as we call it) the lion-type, which in the drawing and measurements exactly covers the Meilen

skull, on the drawing of which also the child skull, from the bronze-station of Auvernier, now in possession of Desor, can be so placed that they perfectly correspond.

"On a close comparison with the skulls in the Basle collection, it becomes evident that the fragment before us is allied to the cranial forms now prevalent in German Switzerland. Our collection possesses only the small number of eight normal Swiss skulls, which have been obtained from the cantons Basle, Berne, Schaffhausen, and Zürich, besides a skull from Bünden of a different shape. The eight Swiss skulls are all distinguished by their comparatively great width and moderate length; they appear, in general, considerably higher than our pile-work skulls; still there are two skulls, of Schaffhausen and Zürich females, which in height do not exceed the height of the pile-works' skulls."

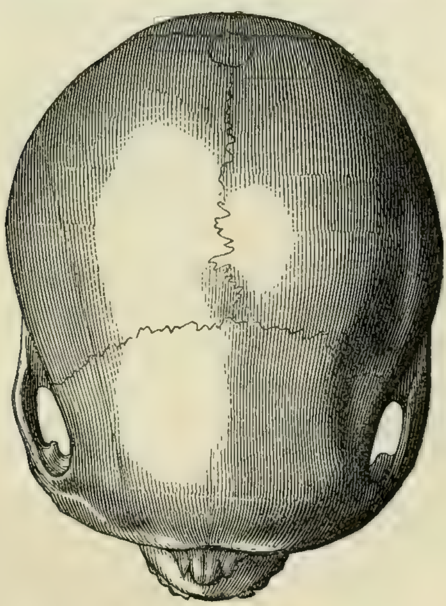
Prof. His further justly observes, that neither the skull of Meilen nor the Swiss skulls present the decided characters of dolichocephaly or brachycephaly, but are more allied to the brachycephalic shape by the great width of the occiput. In the Meilen skull the proportion of length to width is 100 : 83·2, by which this cranium, as the Swiss crania in general, approaches the crania of the Lapps, in whom, according to Welcker's table, the proportion is 100 : 84, and who are now generally considered brachycephali. The same type of proportionally large and wide heads with prominent supraciliary arches, square forehead, broad and projecting parietal prominences, and projecting occiput, has been at all times the dominant form of all Swiss skulls. Undoubted crania from pile-works which contained only bronze objects, specially a young cranium found in Corcelettes, now in possession of my friend Desor, in Neufchâtel, possess the same characters as the skulls found in more recent graves.

The skull taken from a Roman grave near Geneva, belongs, as I have since convinced myself by comparison, undoubtedly to that type; it is consequently a Swiss skull of the Roman period. Among thirteen skulls of Grenchen, from which I excluded four children—and female skulls, besides two decidedly narrow skulls, the remainder gave the mean proportion of 83·8, and

thus belonged to the same type. Professor His is of the same opinion. "We thus possess," he observes, "in the pile-works

Fig. 123. Profile of a Helvetian Skull from a Roman grave near Geneva.

Fig. 124. The same Helvetian Skull viewed from above.

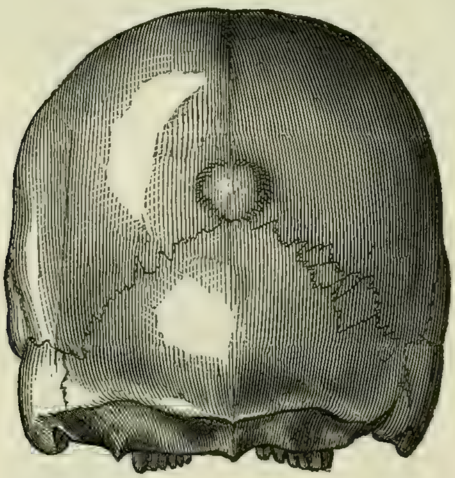


of the stone, bronze, and iron periods but *one* type, the Helvetian, which has been transmitted to the present period, so

that Troyon's theory of the succession of different pile-peoples becomes very doubtful. There remain only the children's skulls of Plan d'Essert and a fragment of an old skull of Wallis, both in possession of Troyon, which certainly do not belong to the Helvetian type, but to our square so-called Dissentis type, and which according to Troyon belongs to the bronze period.

Further researches will show whether the Swiss skull really has a tendency to an open frontal suture persisting in advanced age. Several skulls of Grenchen present this peculiarity, which is also shown in a skull sent me by Colonel Schwab,

Fig. 125. Back view of the Helvetian Skull of Geneva. Well developed *Os Incæ.*



which was, according to the assertion of the workmen, found in the vicinity of Biel in a railway cutting, at a depth of eighteen feet in the sand, but which perhaps had rolled down. I may here state that this persistence of the frontal suture is, according to Gastaldi, found in many old skulls dug out near Modena.

There seems also in these Swiss skulls to exist a tendency to the separation of the lambdoid suture. The skull from the vicinity of Geneva has that isolated piece of bone at the point of this suture, which was formerly considered as peculiar to Peruvian skulls, and hence called the bone of the Inca (*Os Incæ*). I saw the same thing in some other skulls of Biel

and Grenchen, also large Wormian bones in the lateral wings of this suture.

When Professor His looks upon it as an important and interesting fact, that since the pile-work period, the cranial form has not in our country essentially deviated from the original type, it merely confirms my own observations on ancient skulls.

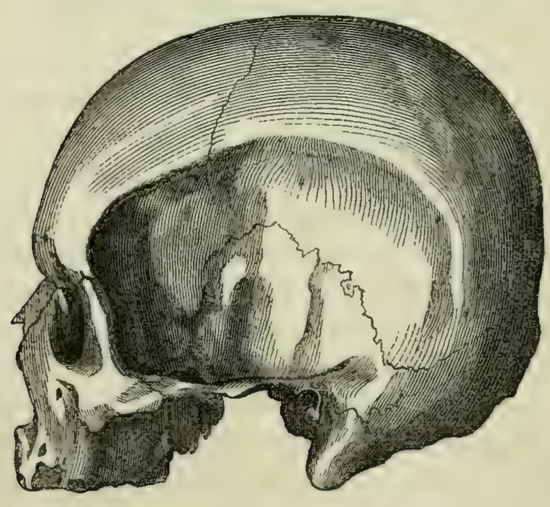
The Rheno-Belgian skulls find their cognates in the long and narrow heads of the Dutchmen who still inhabit the flat lands. The skulls of Lombrive are allied to those of the modern Basques, the stone skulls of Denmark are allied to those of the Lapps and Fins, who have been driven to the north. The stone skulls of Switzerland present the type dominant in that country at all periods. Even the existence of a short-headed race, of which the relics are found in some graves in Wallis and Waadtland, need not surprise us when we assume that this present Romanic type has, from the stone-period, been as prevalent in Eastern Switzerland as the Helvetian type in Central and Western Switzerland, and that across the St. Gothard and on the banks of the Lake of Geneva it gave the hand to the Helvetian type. Pruner-Bey, as stated in another note, thinks he has recognised this brachycephalic type on the Waadtland banks of the Lake of Geneva, which, according to him is also the type of the skull from the Tinière cone; and, if this view of Pruner-Bey is correct, which by the way cannot be quite inferred from his description, we obtain thereby an additional proof in favour of the remarkable constancy of cranial forms even in very limited localities. We thus find in the oldest prehistoric times every where very diversified races as distinct in form as Negros and Europeans are at present; but nowhere do we find any proofs of migrations or radiations from a common centre over the habitable globe. Though the short-heads might be derived from Asia, it would not apply to the narrow heads, which claim the highest antiquity, as no such heads are met with in Asia. Thus, the facts we adduce from the earliest periods, merely represent man as an original product of the soil he then inhabited and still inhabits. In every such old race there is presented a remarkable constancy of form, the

fundamental type of which is not obliterated, though various intermixtures have taken place with later immigrants.

The constancy of form extends even to apparently trifling circumstances. When Von Baer, in his treatise on Romanic skulls, says that the Alemannic stock had, generally, a wider and shorter skull than the Franconian or Hessian, it is perfectly correct; but it should be added, that there obtain great differences even within the Alemannic stock; thus the Suabian skulls are much shorter and rounder than those of the neighbouring Swiss, which are so much distinguished by their angular form and greater length, that the skulls of the battle-chapel of Dornach can be easily distinguished and separated accordingly.

It would be a great mistake to believe that there occur in Switzerland no other types than those mentioned, and which are perhaps as old as the cranium of Meilen, or perhaps the remains of later, though still pre-historical immigrations. Baer has drawn attention to that remarkable brachycephalic form which occurs in the Grisons, and of which I here give some outlines of the skull of a very aged man, taken from a

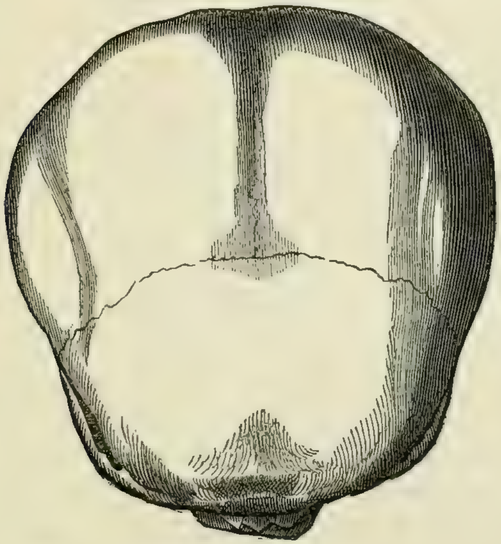
Fig. 126. Romanic Head of the Grisons in Profile.



Geneva churchyard, now in possession of my colleague, Professor Claraparède.

The greatest width of this skull lies immediately above the auditory apertures, and is so considerable that it almost equals the length, the difference being only a few millimeters.

Fig. 127. Romanic Head of the Grisons, top view.



From the vertex, situated in the centre of the sagittal suture, the occiput descends almost perpendicularly to the occipital spine. The line of the cranial vertebræ is comparatively very short; the occipital foramen is, by the disproportionately short neck, placed very far back, so that the skull is not balanced upon the articulating surfaces. On viewing the skull from above, it presents a very broad oval, the apex of which is towards the forehead. Von Baer has raised the question whether these remarkable short-heads, which are found in their purity in the higher mountains of the Grisons, may not owe their origin to the old Etruscans. Why, they differ as night from day; the few old Etruscan skulls authenticated as such, and preserved in Italy, are decided narrow-heads. We have but few facts enabling us to give an opinion on the commixture of different types amongst the Etruscans. As in the Grisons, along with the skulls, the marsh sheep and the marsh hog (*Sus palustris*), both of which were domestic animals in the

stone-period, have been preserved, it may reasonably be inferred, that the Romanic skull-type had originally existed in that district of the Alps, at the same time, and by the side of that entirely distinct people, which erected the pile-works on the lakes and marshy plains.

Whilst these human races, we have hitherto considered, have furnished us with proofs that they had inhabited the same soil from pre-historic down to historical times, and when we find no traces of their having left their earlier habitations for adventurous migrations to Europe, we should expect something similar as regards domestic animals. As the domesticated animal is more dependent on man than man on the animal, we are justified in supposing that domestic animals are equally the products of the soil which they inhabited together with man, and that the original domestic animals which man subjected should be the descendants of wild species then existing in that region. It will be necessary to consider such domestic animals so far as they throw light on this question. I cannot do better than give you the interesting results of the researches of Rütimeyer, and I shall frequently quote his own words.

The oldest domestic animal now known was undoubtedly the dog, which is found both in the Danish kitchen-middens, and the Swiss pile-works. This oldest dog belongs, according to Rütimeyer, to a middle-sized race, of light elegant structure, with rounded cranium, large orbits, short-pointed snout, and moderately developed regular rows of teeth. This dog, which might be called the marsh-dog (*Canis palustris*) resembles in its size and slender limbs both the setter and the hound. The former as regards the transverse diameter of the skull, and the latter as regards the general outlines and the longitudinal diameter. This house-, or turf-dog, of the stone-age, must be considered as perfectly distinct a race from the wolf and the jackal, the pretended progenitors of the present domestic dog. As it is found both in Denmark and Switzerland, there can be no doubt it was a canine race peculiar to Europe, which man first subjected, and used it for the chace, and subsequently to guard his flocks. In support of this view, Rütimeyer men-

tions the circumstance that dog-bones are rarely found broken for the sake of the marrow, as is the case with all other bones of animals which served as food, and that most dog-skulls belonged to old animals, whence he infers that only in case of necessity were dogs eaten, and that they were allowed to live to an advanced age. In the metal period, there appear, both in Denmark and Switzerland, larger and stronger races of dogs, approaching the wolf-dog or the bull-dog in their dentition, rather than the marsh-dog; and which certainly may have been imported. The constancy of the characters of the marsh-dog, the perfect conformation of its remains found in various places, its specific difference from the wolf, fox, and jackal, support the assertion that the great variety of canine races is not the result of the transformation of a single species, but of the intermixture of many different, but nearly allied, species.

Rütimeyer distinguishes two well characterised races of the swine family of the stone-period. The proper wild hog (*Sus scrofa*), the propagation of which has been checked by civilisation, but which then extended over all Europe, and the much smaller animal, the marsh- or turf-hog (*Sus palustris*), which is distinguished by various other characters, so that it must be looked upon as a well marked distinct species. The wild marsh-hog had probably a more limited sphere than the wild hog proper, for whilst the former has hitherto only been met with in Switzerland, remains of the latter are frequently found in the Danish kitchen-middens. On the other hand, the Danish kitchen-middens contain no traces of the domestication of the swine, or indeed, any other animal, excepting the turf-dog; nor have there in some of the oldest stations of Switzerland, as at Wangen and Mosseedorf, been found any bones of hogs bearing the character of domestication. In stations of a later period, the domesticated marsh-hog is met with, and though at first the bones of the domesticated hog are less numerous than those of the wild boar, the proportion is soon changed, showing that in consequence of its great fecundity, which it shares with all swine species, the breeding of the marsh-hog soon became of essential importance to the pile-builders. Rütimeyer further considers that as a wild animal, the marsh-hog had become extinct

before the historical period, but that it agrees in its characters so much with the middle tertiary hog, that this race may have descended from it. As the hogs from the caves and the alluvial formations agree so greatly with the wild hog, the latter and better armed type, which appeared later, would have supplanted the older and weaker race, had not man taken it under his protection, and so preserved it to this day. There is even now bred in Graubünden, Uri, and Wallis a small, round-backed, short-legged race, with short erect ears, short thick snout, long bristles, and of uniformly black or reddish brown colour, the osseous and dental structure of which agrees with that of the marsh-hog. It is therefore highly probable that this race is descended from the extinct wild marsh-hog, and that by domestication it acquired a more sloping forehead, a shorter occiput, and less curved zygomatic arches. The Indian or the Siam hog, which in Asia is not found in a wild state, but is a widely-spread domestic animal is said to approximate most nearly the tamed marsh-hog. Still the material for comparison (a drawing of a skull by Daubenton) placed at the disposal of Rütimeyer, is so scanty that nothing certain can be inferred. The wild hog was undoubtedly the ancestor of most central-European large-eared domestic swine. During the stone-period it was in a wild state; it is only in Concise, the Neufchâtel lake, where, as already stated, the civilisation of the stone-age was at its acme, that relics of the domestication of the wild hog were found. "I must confess," says Rütimeyer, "that the scanty traces of the tamed wild hog, by the side of the abundant relics of the tamed marsh-hog, seem rather in favour of the introduction of a new race into Concise, than in favour of the domestication of the wild hog by the lake dwellers, the more so as at Concise traces of the cow belonging to the trochoceros race appear, which are absent in the earlier pile-works."

Be this as it may, the domestication of the common wild hog, which inhabits Europe and the shores of the Mediterranean, is not derived from Asia, where other wild hog races exist, but originated in Europe—possibly, as we shall presently see, in the regions of the Mediterranean. We have here a repetition of the phenomena in the canine race, namely,

that the present races are descended from originally distinct species, which intermixed with each other and with various foreign types.

As regards horned-cattle, there occur in the pile-works of the stone period two wild species of gigantic size, the Urus *(Bos primigenius)* and Wisent *(Bison Europæus)*, whilst the Urus only has hitherto been found in the Danish kitchenmiddens, and the different beds of France (Amiens, Aurignac) associated with the remains of man. The Urus was unquestionably a contemporary of the mammoth and of the rhinoceros with the bony septum, the teeth of it having been found with those of other species of elephants and rhinoceros *(Rhinoceros leptorhinus)*, in the slate coals of Dürnten. In earlier pile-works, the bones of wild animals, such as those of deer, are much more abundant than those of cattle, but subsequently the latter preponderate, a proof that the settlers gradually turned from the chase to agriculture. According to Rütimeyer's researches, the Frisian race of oxen, which in size are not much behind their gigantic progenitors, are descendants from the urus. It almost seems as if the domestication of the urus, which was hunted, according to the Nibelungen song, in the forests of Worms, was merely attempted in the stone period, but soon abandoned in favour of other races. In the north, however, the breeding was continued down to recent times, and produced in marshy regions that race which even now exceed in size all other bovine races.

The Bison, Aurochs or Wisent, has evidently a more limited sphere than the urus; its relics have, as yet, not been found associated with those of the mammoth and the rhinoceros—it is only in the peat that they occur with those of the Irish elk. The Wisent has never been tamed, though it was in historical times spread over central Europe, and is mentioned by the side of the Urus in *Siegfried's Chase* (Nibelungen song). The Bison always was a chase animal; it still exists in the forest of Bialowice in a single herd of about eight hundred animals, which, no doubt, has been much diminished during the present insurrection.

"Under the name *Bos longifrons*," says Rütimeyer, "Owen has

described the relics of a small species of oxen which are frequently found in postpliocene strata in England associated with the bones of the elephant and rhinoceros, and in the peat bogs of Ireland with those of Irish elk *(Megaceros Hibernicus)*, and in more recent formations with those of the common stag and Roman antiquities. Owen supposes it to be the original stock of the small short-horned and hornless cattle which are bred in the highlands of Scotland and Wales under the name of kyloes and runts, which in Owen's opinion, constituted the tamed cattle of the Britons before the Roman invasion." Owen had previously given to this species the better name of *Bos brachyceros*, whilst Rütimeyer named it the marsh-cow. The small slender-footed species, which appeared earlier in England and Scandinavia, and was distinguished by its comparatively short and thick horns, was by the oldest inhabitants of Wangen and Mosseedorf, during the stone period alone, domesticated along with the urus and some other races. The small uniformly coloured race of Switzerland, the so-called brown cattle, the breeding of which on account of the richness of the milk has reached the highest perfection in Schweitz, is no doubt descended from the above, and perhaps also that race now very common in Algiers and the north of Africa.

In Concise and Chevraux on the Neufchâtel lake were found remains of an ox, with flat, almost square forehead and nearly semicircular horns, the size of which is about one-third less than that of its wild progenitor, but in other respects it resembles that large species from the diluvium of Arezzo and Siena known by the name of *Bos trochoceros* (curved-horned cattle).

It thus appears that this species of oxen had been imported into the above-mentioned civilised settlements from Italy, but they were not bred there, and left in Switzerland no permanent progeny. Whether the cow-race now spread in Central Italy be descended from the old stock is worth investigation; but their importation affords a significant proof of the intercourse of the later pile-builders with Italy.

Besides these three races, or rather species (when their remains were found in the diluvium, they were called well marked species—but since they were recognised in a tamed

condition they are again called races) there is a fourth species in Switzerland, the wild progenitors of which are found in the peat moors of Southern Sweden and England, along with the Urus and Bison, and which is called *Bos frontosus.* It is distinguished by the convexity of the forehead between the eyes, by long and outwardly curved horns, it is smaller than the Urus, but larger than the marsh-cow. It is absent in the pile-buildings and in the peat bogs, but is now represented in Switzerland by the so-called spotted cattle (the Simmen or Saanenthal race), and has thus been introduced within historical times, very probably, from the North.

"In the stone-period," says Rütimeyer, "we find a sheep, which, by its small size, slender extremities, and, still more, by its upright, short, goat-like horns, differs from the common existing ovine races. Wauwyl alone furnished remains of large and curved-horned animals. The rarity of horns renders it impossible to explain the supplanting of those short-horned animals by the present race. On examining, however, the bones of Chavannes, Echalens, &c., we find that in the middle ages large curved-horned animals were widely spread." This peculiar small sheep, with coarse wool, may be called the *turf sheep.*

A wild stock, from which the goat-horned turf-sheep might have been derived, no longer exists, whilst the curved-horned sheep, to which belong all domesticated races, might have had as its progenitor the Mediterranean Mouflon and the Asiatic Argali. On the other hand, there were found in the caves of the South of France, specially at Lunel-Viel the remains of a sheep resembling the turf-sheep of the stone-period, so that the species reaches back to the oldest period of the human race, as human bones were also found in this cave. Again, in the most northern islands of England,—the Shetland and Orkney Islands, as well as in the mountainous regions of Wales, and finally, also in the Grisons, there is a race of sheep bred, the skulls of which correspond in size, form, and shape of horns to those of the turf-sheep of the stone-period. There seems, therefore, no doubt that the wild turf-sheep was a native of Central Europe, that it was soon subjected by man, but that it

was subsequently supplanted by the importation of the curved-horned sheep, which excelled it alike by a finer wool and the flavour of its flesh.

In the pile-works of the stone-period the goat is much more frequently met with than the sheep; but in the later settlements the proportion is reversed. It is the same race which at present exists in Switzerland, which may have been wild at one period.

"Horse bones," says Rütimeyer, "are in the pile-works of the stone-period much more rare than the remains of man, and as we cannot imagine the horse to have been buried with man outside the pile-works, we can only conclude that the horse was wanting to the early pile-builders, and even occurs but sparingly in the later settlements of the same periods; so much so that I am led to suppose that the few horse relics found in Robenhausen, Wauwyl, &c., have been introduced into the pile-works as booty; the mode of life of the pile-builders seems scarcely compatible with horse-breeding.

"It is almost superfluous to add, that all the horse-remains found are those of the domestic species, and entirely distinct from the fossil horse."

The teachings of the cultivated plants are analogous to those derived from human and animal relics. Apples and pears, prunes and hazel-nuts, raspberries, bilberries, &c., were manifestly eaten and partly cultivated by the pile-builders. What they specially planted was wheat, barley, and flax, the seeds of which may also have served for food, whilst the fibres served for various textures. The grains of the wheat are much smaller than those of the wheat now cultivated. Barley in the old settlements was six-rowed, in the later settlements it was also found two-rowed. Rye, oats, and hemp, which, according to botanists, are natives of the East, whence, as many believe, the pile-builders had emigrated, are entirely absent. "We may assume," says Dr. Christ, "that the pile-inhabitants, true autochthons of our country, have never visited the rye and oats districts, that is to say, Eastern Europe, whilst wheat and barley, perhaps, came from the south. Wheat was at all events the first cereal cultivated by man in our northern regions."

The introduction of both these cereals from the south appears to us any thing but proved. Barley, of all cereals, grows further northward; it may, therefore, even in such an inhospitable country as Switzerland must have been at the pile-work period, have grown wild; and it is just as probable that wheat, which is only a cultivated wild-growing cereal, may have been improved by cultivation, as appears proved by the smallness of the grains in the old ears.

The result of all researches touched upon in this Lecture evidently shows that man, with his whole domestic economy, including the useful plants and domestic animals, was developed on the soil, where he left his earliest traces; that he there procured his means of subsistence, and that it was only at a subsequent period that he came in contact and intermixed with other races of mankind developed in another region. The facts, as far as they are known, establish merely the original difference of mankind, and that man, the domestic animals, and the useful plants were natives of the soil where they were developed. Beyond this all is tradition and hypothesis.

LECTURE XIV.

Transmission of Characters.—Natural Races.—Theory of Nathusius.—Objections to it.—Distinction between Races and Species.—Transformation of Varieties into Races and real Species.—Influence of Time.—Raceless Animals.—Mongrels and Hybrids.—Their Propagation.—Wolf-Dogs.—Buck-Sheep.—Rabbit-Hares. —Their Breeding.—Conclusions and Inferences from the preceding facts.

Gentlemen—In discussing the questions concerning the origin of the groups, races, and species composing the animal creation, including man, the consideration of natural generation always occupies the foreground. The existence of the whole animal creation in its various forms and species, depends solely on normal propagation, as the existence of every living being is limited by death. It is the more requisite to enter into particulars regarding these questions, as the views on the origin of mankind and animals, their affinity, descent, and their transformation in the course of time, depend on the solution of the above questions.

There can be no doubt that both sexes, male and female, co-operate in the generation of the higher animals, and that the characters of the parents are transmitted to their offspring. We have seen that the family forms the basis of the various groups in the animal world, and just as every individual possesses some, though frequently insignificant peculiarities, which impress upon him the stamp of individuality, so does the family present special characters which enable the observer to trace their origin. It has been said that the distinction of individuals extends only to domestic animals, that in other animals there exist no peculiarities by which we can distinguish the individuals, and I have even lately seen some religious tracts in which this assertion is used as a proof of the exceptional position of man in creation. Every taxidermist at any museum

can easily refute such an assertion, and prove that in a herd of wolves, for instance, the individual difference is as great as in a flock of sheep propagated by inbreeding. If the assertion of perfect resemblance were well founded, no collector would take the trouble to make a selection. There obtains, therefore, an individuality in the whole animal kingdom just as in mankind and the domestic animals, and if, in common life, we pay no attention to it, it is because we see no use in so doing.

The transmission of individual characters, which distinguish not merely the species, but also the family and the individual, is thus one of those facts which must have a general influence on the forms of the animal kingdom, and it is the transmission of peculiarities distinguishing the individual which has become such a powerful lever in improving the breeds of our domestic animals.

Virchow has recently, in an excellent treatise, raised the question whether the sum of characters transmitted is always the same? As was expected, he arrived at the conclusion that this neither is nor can be the case, for the simple reason, that a change of the established family-type would thereby be rendered impossible. The possibility of any alteration rests upon this: that the hereditariness embraces an undeterminable sphere of characters, the extent of which can only be learned by experience. It is frequently impossible to predict whether this or that animal, possessing otherwise some excellent qualities, may not transmit to its progeny some germ of disease, which only breaks out at a later period, while apparently inferior animals produce a stock suitable for the purpose of the breeder.

I have in a preceding lecture explained that the word "race" in the sense in which it is used, cannot be separated from the notion "species," since the constancy in the transmission of characters, the resistance against external influences, and the adaptation to surrounding media, are frequently as great in races as in the so-called species, and may be traced back to remote antiquity, as is done in species. The term "race" expresses, perhaps, only a theological idea. Applied to domestic animals it is often used as equivalent to species, as it was known that

these races had partly arisen by the interference of man, whilst for the origin of species the direct interference of a creator was assumed.

"On comparing," says Nathusius, "the existing forms of domestic animals proper, we are met by a decided contrast: we acknowledge races so far firmly established, when we find a large number of individuals, representing by resemblance and common characters definite groups, originally more or less confined to certain localities, which have in historical times remained unaltered. Such animals constitute natural, geographically established races. In contrast to them we have artificial or cultivated races.

"By these we understand those domestic animals which are cultivated and developed by the interference of the science of rural economy. They owe their origin either to natural races —to so-called inbreeding—by the coupling of such individuals as are distinguished by some excellent qualities; or by the crossing of different natural races, in which the individual character plays a more important part than the race-character. The descent of the artificial races is thus of secondary importance; they have no natural home, but are dependent on the state of rural economy. The term 'full blooded' is commonly considered as equivalent to cultivated race; but the definition of this word, now so much in use, based upon the notion of unity of race, is erroneous.

"Natural races must be characterised by zoological characters, though we must not forget that we have before us not species, but varieties, and that sharply defined limits are not applicable to transitional forms; yet, such transitional forms are always present; for variableness conditions the notion of race." (Within equally wide limits is the notion of species; for variations, *i.e.* extraordinary forms, which are not constantly propagated, occur also in species,—*e. g.* in fox, Cebus, lion, panther, etc.—as well as in races.)

"The assumption that all domestic animals proper, and specially the natural races, are derived from this or that wild original stock, neither is nor ever will be proved. Still the assumption is considered so well founded, that we rarely hear

any doubt expressed upon this point. There is, however, another theory equally founded upon experience.

"Neither of these opposite assumptions can, however, be decided by experiment; the correctness of either lies beyond the province of systematic natural history; the solution pertains to another province, which cannot be opened by the sensual keys of science.

"The opposite assumption then is, that there are *created domestic animals*. The condition of domestic animals may possibly be a specific not an acquired quality, just as the life of animals in the forest, or in the steppe, is a specific not an acquired quality. Those who believe that man is not a gradually developed animal, but a creature animated by the breath of God, cannot find it strange that there are animals which, at their creation, were not merely endowed with the capacity for domestication, but were, for the use of man, at once created domestic animals.

"There is a theory which scouts the word 'creation,' which knows of no creation, but only of a so-called development from the primitive mud; from this quarter we expect the reproach of simplicity. Our view, by acknowledging that experimental science has its limits, includes the assumption of a peculiar quality for the racial differences of mankind, according to which neither the notion of species nor of variety is applicable to man as applied to the organic creation in general. When, therefore, we speak of human races and domestic races, these notions of race may be founded upon a peculiar principle of differentiation exclusively belonging to these created forms. The relation of the domestic animals to man renders it intelligible that such a distinguishing principle is applicable to both. If in the notion of race, applicable to man and domestic animals, we only attend to qualities furnished by observation, and to the exclusion of all other qualities observed in species and varieties, many difficulties will be solved in the contest concerning the unity of mankind and the descent of domestic animals. There is thus in what we term races no longer any question about the production of hybrids between species, about the incapacity of real hybrids to propagate themselves regularly; there is no

longer any question about pliancy of species, nor about stability of varieties.

"Without attempting to fathom the question here raised, I would only mention once more, that those animals which have been domesticated within historical times are not included in our considerations. It is conceivable, though not demonstrable, that some domestic animals originated from a wild parent stock, and that consequently the hog does not belong to primitive domestic animals. Even the question of the relapse of domesticated animals into the wild state, of which the swine afford so many instances, must not divert us from our theme.

"Such a theory leads us to primitive or original races; but the question concerning their origin, their unity, or plurality, in every animal species, lies beyond the limits of observation."

This long extract from Nathusius, plainly shows that a single deviation from the right path of inquiry leads to a number of wrong conclusions. In order that man should correspond to the religious idea of being a special being, produced by a direct divine interference, he is thrust into an exceptional position. But as it is observed that the domestic animals and their natural races stand in evident relation to human races and stocks, and as specially as regards generation and propagation the conditions are nearly identical, it becomes requisite to assume for the domestic animals also an exceptional position. The intelligence of man, they say, has done nothing for the domestication of animals; they have been created as such for the use of man. But then comes that somewhat fatal objection, that within historic times man has domesticated many wild species. I shall here only mention the turkey, which even now occurs wild in North America, the domestication of which dates only two centuries back. The exception, therefore, does not apply to this nor other domestic animals, nor to the efforts of the Acclimatisation Society; it only applies to animals tamed in pre-historic times, of which we know nothing. But here again we are met by the fact, that the descent of the large-eared swine from the wild boar can hardly be denied; consequently the hog too forms no exception. But how about the Frisian cow, the curved-horned cattle, the large-

horned sheep, whose descent from the Urus, the curved-horned ox of the diluvium of Italy, the Mouflon, is, as we have seen, undeniable? Which are then the domestic animals entitled to claim a place by the side of man? None, certainly, but those whose fossil relics have not yet been found in the diluvial formations, or the older tertiary strata! Whilst thus every day brings forth new discoveries, and makes known to us another domestic animal, the origin of which we may trace to species found in the wild or a fossil state, we are told to claim, for the few domestic animals of whose origin we have no data, an exceptional position, merely for the purpose of supporting a by no means well founded tradition concerning the origin of mankind.

Nathusius, no doubt, tells us: "The solution of the question, whether or not a domestic animal descends from a wild species can be determined neither by observation nor by experiments, as the discovery of the truth lies beyond the means of science"! We doubt whether this principle will be adopted by naturalists. If, as regards the domestic animals and their cognate wild species, constituting by far the most important subjects of natural history, we are referred to faith instead of observation, all experimental science is at an end.

But let us return to our starting point. The observations on the transmission of characters, made by breeders, have not yet reached such a stage that we can infer from them generally valid laws; they have, nevertheless, yielded some definite results. According to Nathusius, the transmission of characters in an artificially bred animal is independent of its origin "generically by the quality of its characters—individually by the proportion of these characters, in reciprocal action with the condition of the vital organs and the energy of their functions; nay, some physiologically abnormal, or diseased organs and their functions, may be the condition for the desired transmission of characters (for the formation of fat, deformity of legs in badger-dogs, (*Basset*, Buffon) etc.)."

These principles being admitted, there can be no doubt, that from this transmission of individual characters forms may arise which are as distant from the primitive form, as other

original forms which we distinguish as well-established species. And this is really the case. If at this day the badger-dog were only found in a fossil state, that is to say, in a condition which would give us no clue as to the origin of its deformed legs, every naturalist would at once declare it a distinct species of dog. The Urus, the marsh-cow, the curved-horned cattle, were all by naturalists, like Cuvier, Owen, Nilsson, and others, distinguished as different species so long as they were only found in the diluvial formations of various countries, and until the present races of cattle were proved to be their descendants. Concerning these races, all physiologists, ignorant of their connection with the extinct races, maintained that they all belonged to the same species—the *Bos taurus,* and tried, with much ingenuity, to prove that they must all have originated from the same parent stock. This proof was founded upon the circumstance that the artificial breeds, the production of which occurred in historical times, differ not less in their characters than the older races, the origin of which is lost in obscurity. They were perfectly right as regards the latter point; they only failed to draw a correct inference, namely, that the same sum of distinctive characters which seems to us sufficient for the establishment of a species, could also, within historical times, have been produced by individual transmission; that it is, therefore, in the power of man, and of present nature, to produce from existing species new varieties, races, and real new species.

Just as the artificial breeds depend on their profitableness, being only preserved by the selection of such individuals as are in the fullest possession of useful qualities, so will the natural race, produced by the individual transmission of some prominent characters, be only preserved and further developed when these qualities are in accordance with the requirements of the animal in its struggle for existence. Artificial and natural races run, in this respect, perfectly parallel, and the only discoverable difference seems to be that man, though he cannot use unnatural means, has the power of selecting, in preference, some natural influences. Let us just

consider the mode in which man proceeds in the production of any race. He finds some animal which appears to him to possess some useful qualities; he couples this with another animal of the opposite sex possessing nearly identical qualities. The breed thus obtained is fed and nurtured in such a manner as to improve, if possible, the desired characters. In the second generation he again selects animals possessing the desired qualities in the highest degree; he pairs them with each other, or with the parent stock, or, in later generations, with the preceding generations, until he has attained his object. Is the process different in nature? It is certainly, in so far as the same starting point is given hundreds, perhaps thousands, of times without further development, because the selection in breeding can be easily effected by the interference of man. But as qualities which prove advantageous to the individual in the struggle for existence also endow it with superior generative powers, this superiority will produce the same result in nature, though at a slower rate than when effected by man by exclusive selection. Thus, with regard only to the higher mammals, it is well known that there is scarcely any species in which there does not exist a kind of courting, leading frequently to fierce combats between a number of males for a certain female, after which the conqueror carries home his bride. Upon this fact rests probably the continuance of the species in the highest development of which it is capable. But since every individual better endowed for the struggle for existence, will transmit his superior qualities, it follows that his offspring will gradually attain an ascendancy, and displace the less privileged individuals, until finally it becomes the sole representative of the race. Thus the same effects which man, by his intelligence, produces in the shortest time, namely, by the application of the most favourable, and the exclusion of noxious influences, are equally produced by nature, the length of time supplying, to a certain extent, the place of human intelligence. Just as in the chemical transformations which take place in the bowels of the earth, length of time is the mysterious factor, so is it the agent in the production of organic forms, which, by apparently insignificant changes, is

finally conducive to a permanently altered type. But this circumstance, that for the formation and permanency of natural races and species, a long period of time is requisite, leads us back to the consideration of a question which occupies a prominent position in artificial breeding. The breeders still debate whether age, constancy, and purity of blood are the essential elements in transmission, or whether the quality of the individual be not the predominating agent. Since even accidental defects, supernumerary fingers, arrest of development, are transmitted and persistent through several generations, it appears that individuality stands in the first rank. Nevertheless the length of time during which a race has maintained itself is of the greatest importance, as the probability of transmission is greater in proportion to the purity of blood and the duration of the race. This is proved by the influence of grandparents, which is so strikingly manifested. When it is said that the influence of the grandparents upon the grandchildren is essentially an indirect one, the assertion is too restricted in presence of the fact that frequently the grandchildren exhibit qualities possessed by the grandparents only and not by the parents. One of my friends has a bitch of the St. Gothard breed, which, excepting a narrow white spot upon the chest, is perfectly black. Two brothers of this bitch were spotted light brown. The mother was black, the father yellowish-brown. The bitch, having been covered by a perfectly black dog of the same race, produced a litter of five puppies, three of which were black with white spots upon the chest, and two with yellowish-brown spots like the grandfather. The peculiarity of the grandfather was here not transmitted to the child but to some of the grandchildren. If cases of this kind are authenticated, and I can vouch for this one, as I possess one of the puppies, and have seen the mother and the brothers, then it is clear that even in the purest blood there are sometimes relapses to the ancestral stock, the qualities of which are deemed extinct, and that, on the other hand, natural races and species maintain their characters even in crossings with great pertinacity, so that they may re-appear in succeeding generations. Thus all dog-breeders know that the blood of a New-

foundland dog, a descendant probably of a native wild species, which was not tamed at the beginning of the seventeenth century, is truly indestructible, so that, after ten generations its characters may still be detected in the cross breeds with other races. Darwin very justly observes, that the coloured rings on the feet, and transverse stripes frequently seen in bred-horses, which are not observed in preceding generations, may perhaps be traces reminding us of their origin. My friend Desor directed my attention to the fact, that in the young of perfectly black cats, the pedigree of which, during several generations, was known, the primary fur was always of a lighter shade, and presented a striped appearance, as in the wild cat, and it was only after the lapse of a year that the fur became perfectly black without presenting any stripes.

Thus all facts combine to show, that by the side of individual influences, there is in transmission another factor, namely length of time, which gradually establishes a certain type best adapted for a constant struggle for existence, and which is the more permanent the longer the conditions for existence remain unaltered. But the greater the fixity of this type, the greater the demarcation from allied, and its hostility to other types; the gulf which separates it from the latter was inconsiderable at first, but it gradually enlarged until it became impassable.

Whilst thus the significance both of the natural and artificial races of pure blood is certainly very great, we consider it at the same time a step in a forward direction made by Nathusius in distinguishing "*raceless animals;*" which, according to this author, have arisen: "Either by the transportation of natural races from their native country to foreign parts, not offering them the same conditions for development, and where their racial type was altered, without the assumption of a fixed typical form; or by the crossing of different natural races, which in their progress are not led to a typical form; or, also, when artificial races are not attended to with the requisite care, so that by hunger and other deprivations they relapse into their original state."

That from this chaos of raceless animals, partly by natural

influences, and partly by artificial breeding, new well characterised races and species may arise admits of no doubt. In the raceless animals of the first category which are produced by transplantation into other regions, that formative process takes place which we have just characterised and by which a fixed type is gradually produced corresponding to the altered conditions. In so-called degenerate animals, which by want of care approach the original form, this racelessness must cease when the relapsing process attains its limits; so that of the three cases established by Nathusius two have only a temporary limited value, whilst the third — the racelessness produced by the crossing of different races, is more generally applicable.

Let us now examine more closely this point concerning mongrels and hybrids, for which purpose we must return to the terms "variety and species."

Every naturalist who has critically examined the question of species has arrived at the conviction, that the conception of species does not always consist in a definite sum of distinctive characters; but that, on the contrary, in each group both the sum of the characters as well as the chief characters differ essentially. We possess genera in which every species has as sharply incised characters as an antique gem; there are others (especially genera with many species) in which the species as it were coalesce, and can only with difficulty be distinguished, frequently grouping themselves around a centre, so that within one genus several principal species arise, around which other species place themselves. These groups of allied species arise by their possessing some chief character in common, whilst some other characters may differ in allied species. The sum of the distinctive characters, as well as their quality, has in every type we examine its particular laws, which cannot be generally formalised. But we have seen that both quality and sum of distinctive characters may in different races be as great and even greater than in different species. The characters can thus only serve for determining the races, when we admit that race and species are identical, and inseparable conceptions.

But we are told: Species have persisted since times imme-

morial, not so races; species have always propagated in the same manner, races have been formed under our own eyes; species are imperishable types, races disappear as they have come. We were enabled to show that all these distinctions lost their significance through modern researches; that the chief races of our domestic animals trace their origin as far back as the wild species which surround us; that they have propagated exactly in the same constant manner as these wild species;—that finally wild species have disappeared from the creation like tamed races; that consequently all distinctions vanish, and that race and species are in this respect perfectly identical.

Thus there remain only the conditions resulting from generation. Races, it is said, can interbreed and produce a progeny indefinitely prolific. Species, it is said, sometimes interbreed, but their progeny is sterile, if not in the first, certainly in subsequent generations.

This principle, if firmly established, leads, it is believed, to the inference, that all races spring from a single stock, but all species from different primary stocks. Let us first examine how it is with the species, and let us confine ourselves to the mammals which stand nearest to man.

There can be no doubt that animals even in a wild state pair or endeavour to copulate with races not allied to their own, such is especially the case with males driven away by stronger rivals, who, in the impossibility of gratifying the sexual desire with females of their own species, pair with those of other species with whom they frequently come in contact. This phenomenon resembles that of the adoption of the young of other species by a mother deprived of her own progeny. Connexions of this kind have been observed between dog and swine, stag and cow; but it was always found that in species so remote from each other there was no issue, which is frequently impossible from incompatible organic structure. We may, therefore, from actual observation, consider it as a law, that copulation between remote species differing in structure is either impossible, or, at all events, sterile.

Allied species may copulate and produce bastards. This is

frequently effected by the interference of man, when generally some tricks are required to deceive the male and so to conquer its aversion to a female of a different species. The stallion who is to cover a she-ass is frequently first excited by the presence of a mare, for which at the proper moment the she-ass is substituted. The same manœuvre is often resorted to, to induce thorough-bred stallions to cover plough horses. They frequently refuse, until one of their favourite mares is produced, after which they are deceived in the above manner. But though in common cases, the interference of man is requisite for the production of hybrids on a larger scale, there are a sufficient number of cases known of the occurrence of hybridity in a wild or semi-wild state. Dog and she-wolf, fox and bitch, dog and jackal, ibex and goat are authenticated instances of this kind.

The hybrids present in the average a mixture of the physical and mental characters of the parents. There persists, however, a certain individuality, as the intermixture does not affect the separate organs in equal proportions. The description of wolf-dogs as given by Buffon, shows very clearly how far this difference may extend to the young of a single litter.

Whilst thus the production of bastards with characters equally remote from those of both parents may take place with or without the interference of man, the question whether intermediate species may arise is not thereby solved. It is not merely requisite that the hybrids should be able to interbreed, but that their progeny should be prolific so that the species may be continued; for, unless this were the case, the new species would become extinct. Supposing that the hybrids are not prolific between themselves, but are so with the parent stock, the hybrid character would, after a few generations, become again obliterated. Let us suppose a wolf-dog, half-wolf, half-dog, covering a bitch. The offspring is now only one-fourth wolf and three-fourth dog, and if this three-quarter dog and his progeny are crossed with bitches, the quantity of wolf-blood must finally be so much reduced as to be no longer perceptible. Traces of such an intermixture will now and then appear in some of the descendants, which, perhaps, may

present some wolf-character, just as a race-horse may show zebra stripes about the feet; but, generally speaking, the hybrid race disappears, and is absorbed in the original stock.

Experience now teaches that fertility among hybrids differs in a remarkable degree; that each species has its own law; that there obtains even a difference with regard to the sexes of the same species. The he-goat pairs readily with the sheep, and produces hybrids which, according to Buffon, are perfectly prolific. The ram, on the other hand, copulates unwillingly with the goat; and, according to the same naturalist, there never is any issue. The probable production of prolific young, as Broca justly observes, by no means depends on the external resemblance of characters.

The greyhound and poodle dog are, both externally as well as in the structure of the bones, much more dissimilar than horse and ass (though greyhound and poodle are considered races of the same species, but horse and ass as different species), and yet the former produce fertile, and the latter a sterile progeny. Observation alone can furnish us with data; and observation, we must confess, extends at present to but few species.

There are cases in which the sexual function of hybrids is extremely limited, in which the bastards may copulate, but are sterile. Mules may sometimes produce young, but they must be covered by a horse stallion, and the progeny are usually sterile, and possess little viability. This example, which is the oldest and best known, is the only one, and may be considered as exceptional. Mule breeding has been carried on in the East from the remotest antiquity, and it was reserved to the enlightened government of King Otho of Greece to ignore a thousand years' experience, and to import from Portugal, at a great expense, mule stallions for the improvement of mule breeding in Greece. This example of sterile hybrids is constantly quoted by those who maintain "all hybrids are generally sterile in the first or the next following generations."

Broca cites an instance of a limited hybrid production between the American bison and the European cow. The bison readily covers the cow, whilst the domestic bull manifests an aversion to the bison-cow. The progeny from such a connec-

tion, which the Americans term "half-blood buffaloes" (they call the bison buffalo), have the body of a cow, but the curved back (without the hunch), the colour, the head, and the mane of the bison. The hybrids seem *inter se* but little fertile, but if the half-blood is crossed with the parent stock a quarter hybrid is obtained, which is very prolific, and produces a permanent hybrid species which, with all its characters, is indefinitely fertile. This too is, at present, the only known instance of a semi-fertile hybrid progeny, in which the bastards produce *inter se* a sterile generation, but after being crossed with the parent stock produce a species fertile between themselves and the parent stock.

The cases in which hybrids are fertile and produce a constant mongrel race are abundant. As cases of this kind are contested with the greatest obstinacy, I shall quote a few from the description given by Broca.

Experiments by Buffon :—" A young she-wolf, scarcely three days' old, was found in a forest by a peasant, who sold it to the Marquis Spontin-Beaufort, by whom she was brought up. She became so tame that she was taken out hunting. When a year old she became so savage as to kill fowls and cats, attacking dogs and sheep, so that she had to be chained. One day she bit the coachman so dangerously that he was laid up for six weeks.

" First litter.—On the 28th of March, 1773, this she-wolf was first covered by a pointer, of whom she was very fond. The act of coition took place repeatedly during a fortnight. Seventy days after the first coition, June 6, 1773, she cast four whelps, three males and one female.

" Second litter.—A single male remained, which was brought up with his sister. On December 30, 1775, at the age of two and a half years coition took place between them, and sixty-three days after, on the 3rd of March, 1776, the bitch cast four whelps, two males and two females.

" Third litter.—A couple of this second litter was sent by Marquis de Spontin to Buffon, who kept them first at Paris, and subsequently at his country seat. Both animals were brought up together, and carefully watched to prevent

their intermixture with other dogs. Coition took place December 31, 1778, when they were two years and ten months' old, and after sixty-three days the bitch cast seven whelps. The keeper took up the whelps to examine them, immediately after which the enraged mother killed and devoured all those the keeper had touched. There remained but one, a female.

Fourth Litter. This female was brought up with its parents in a large vault, into which no other animal was admitted. At the beginning of 1781, when about two years old, the young bitch was covered by her father, and cast in the course of the spring four whelps, two of which she devoured. There thus remained one pair, of whose fate we learn nothing. The French revolution probably interrupted these experiments.

The hybrids of he-goat and sheep, which we term "buck-sheep," (*chabins* by the French), are bred in large numbers in Chile, as their long-haired, half-woolly fleece, known by the name of "pellons," is much sought after for bedding, carpets, and saddle-cloths. The buck-sheep of the first generation have the form of the mother and the hairy coat of the father. The hair is, however, almost as stiff as those of the he-goat, so that the fleeces are but little valued. These bastards are consequently not bred from, though they are perfectly prolific between themselves; a small number only is retained for further breeding. The buck-sheep which furnish the most valuable skins, are those of the second generation, and are obtained by the crossing of the male buck sheep with ewes. These half-blood buck-sheep are, as far as we know, indefinitely prolific; but after three or four generations their direct descendants undergo a modification which diminishes their commercial value: their hair becomes thicker and harder, thus approaching that of the goat, which is the more remarkable as these half-blood buck-sheep are one-fourth goat and three-fourth sheep, and are thus much nearer the sheep than the goat. Still more remarkable is it, that in order to re-endow the succeeding generations with fine and soft hair, the females must be crossed with the males of the first blood. We thus obtain a mongrel, with three-eighth goat blood and five-eighth sheep blood, which does not stand so near to the sheep as its mother, and yet possesses a softer

fleece, the excellence of which is preserved through several generations. The buck-sheep exactly resemble our domestic cross breeds, which after some generations lose some of their useful qualities, which can be recovered by a fresh crossing within the race. The fertility of the buck-sheep is not limited, as the crossing is not effected with the parent stock, but on the contrary with hybrids.

Fox and bitch, jackal and bitch, ibex and she-goat, camel and dromedary, llama and alpaca, vicuña and alpaca, all produce mongrels productive between themselves and infinitely prolific, some of which, as the bastards of the dromedary and the camel, are more valued than the parent stocks. We cannot enter into particulars, excepting in one instance which has recently acquired some importance in its industrial aspect, we allude to the breeding of hybrids of the hare and the rabbit as carried on in France.

M. Roux, of Angoulême, took young hares from three to four weeks old and brought them up with tame rabbits of the same age. The rabbits, who had never seen a male hare, looked upon them as their natural mates, and so did the young hares as regards their female companions, although they did not seem so familiar. In order to prevent fierce combats, the males must at puberty be separated and a few females given to each. The crossing is thus easily effected, specially at night, as the hare never approaches the female when under observation. The wild doe-hare casts usually only four young; the rabbit from eight to twelve; the rabbit covered by a hare from five to eight. The prolificacy is thus intermediate.

The half-blood hares, the progeny of the first crossing, resemble more the rabbit than the hare. Their fur has scarcely any reddish tint, the grey being the predominating colour. The ears are somewhat longer than in the rabbit, as also are the hind legs; the facial expression is less wild and timid. They are nearly as large as their parents, so that without close observation they might be taken for rabbits. M. Roux found no advantage in breeding this race, though they are perfectly prolific between each other. If these half-blood males are crossed with tamed doe hares, animals are produced resembling almost

entirely the tamed hare. This breed also presented no practical advantage. It is different with the recrossing with the male hare. The quarter hares of the second blood, the progeny of a hare and a half-blood female, are stronger, finer, and larger than the original stock. These bastards of the second blood, three-quarter hare to one quarter rabbit, resemble their grandmother rabbit as much as their father hare, so that they might be taken as half-blood bastards if their pedigree were not known. The characters of the rabbit thus predominate over those of the hare, probably because the mother was a rabbit. In an accidental cross breed in Italy between male rabbit and doe hare, the particulars of which have not reached us, the young rather resembled the hare.

The quarter hares are prolific between themselves, but only in a limited degree, casting, like wild hares, only from two to five young. To render them more prolific, M. Roux recrossed them with half-blood does.

We shall term this new product three-eighth hares. They are as fine as three-quarter hares, and much more prolific; they cast five to eight young, which are more easily brought up than rabbits, grow fast, and are productive after four months. The female, like the doe-hare and the rabbit, brings forth after thirty days, suckles the young for about three weeks, and receives again the male seventeen days after delivery, so that five litters may easily be obtained within a year. This three-eighth race is that which M. Roux breeds in preference, as it requires no more provender than the rabbit, and yields more meat. A yearling "house-hare" commonly weighs six pounds, a wild hare eight pounds, a three-eighth hare eight to ten pounds; some attain twelve and fourteen pounds, and one weighed sixteen pounds. The three-eighth hares acquire with advancing age a fine fur, which frequently fetches a franc, being of a reddish grey colour, and of the same consistency as that of the wild hare. The market price of a three-eighth hare is about two francs, whilst that of a rabbit is only one franc. The flesh is white, like that of the wild rabbit, but of excellent flavour, resembling that of the turkey.

These three-eighth hares have a thicker head than the rab-

bits, a shy expression, larger eyes, apparently placed nearer the nose, the hind legs are longer, almost as long as in the hare; the fore legs are both absolutely and relatively longer than in the rabbit. The ears are almost as long as in the hare, but singularly enough, in all the young and in most of the old, sometimes the left sometimes the right ear is pendulous, whilst the other ear is erect.

The breeding of these three-eighth hares has been carried on since 1850, and assuming but five litters per annum, we have now arrived at the sixtieth generation, without the hybrids having shown any marked change in their external condition or diminution of their generative powers. Here then we have a proof that two acknowledged different species may produce indefinitely prolific descendants, preserving the same characters. The three-eighth hares have thus become a constant species, with definite characters, which are propagated indefinitely, and thus present all the marks of a zoological species. We will admit that it is an artificial species, which probably would not have been formed in a wild state, it being known that wild rabbits and hares are hostile to each other in this state; and that the rabbits, though smaller and apparently weaker, drive away the hares; hence German sportsmen look upon them as vermin which must be destroyed. They are rarely eaten in Germany; while in France the wild rabbit is considered a delicacy. We will also admit that three-eighth hares, when set at liberty amongst wild rabbits and hares, may lose their intermediate character, and by recrossing may be absorbed in the parent stock, although we possess no certain proof of that. But what bearing has all this upon the point in question? Is the fact hereby altered that a new species has been produced by the crossing of two species, both of which are known to us in the wild state, and one of which has been tamed, whilst the other, in Germany, namely, the hare, has never been domesticated?

Races, it has been said, are distinguished from species by the production of mongrels, which are indefinitely prolific; but on closely examining this point it will be found that the assertion is without foundation.

There are cases where coition between individuals belonging

to the same race is impossible. As little as can the wolf copulate with the Fennec of the Sahara, as little can a bulldog pair with the small hairless African or the Bolognese lap-dog: it is a physical impossibility. Breeders are, moreover, aware, that certain races can only be made to pair with the greatest difficulty, that the prolificacy of the mongrels soon diminishes, and that the race becomes extinct, whilst other races pair readily and are prolific. "There are qualities," says Nathusius, "which are incompatible; hence every crossing does not lead to a fusion of characters." There are accordingly crossings which can never become constant. In other words, there are races which are, but with difficulty, productive between each other, and there are others in which the fertility is limited to a few generations.

The aversion existing between allied species in the wild state has also been considered of importance. We have seen that this aversion is frequently overcome, especially by the males; but we know also that it increases with the difference of the race. Rengger states expressly, that the cats imported into Paraguay, which are now essentially changed, but whose importation is historically proved, have a decided aversion to European cats, and can only with difficulty be brought to pair with them. "Birds of a feather flock together" is an old proverb, and applicable to the whole animal world. It appears to me highly probable that were the Swytz and the Saanen races of our common cattle set at liberty they would not intermix; but that each race would select its own grazing districts, and not intrude upon those of the other race. Possibly, the larger Saanen race may supersede the weaker Swytz race, but no voluntary intermixture would take place.

On summarising the facts obtained in this field of inquiry, we are justified in concluding that, as regards production and propagation, there exists no difference whatever between species and races; that there are both races and species unable to propagate *inter se*; that there are some which only propagate with difficulty; and again others which easily produce prolific hybrids, and thus give rise to new species and races. Experience, however, also teaches, that races and species intermix

with greater difficulty the more distinctly the characters are impressed by the stamp of time.

The chaos of raceless animals, which have not yet received this stamp, exists not merely in races but in wild species, and it will be worth the zoologist's while to bear this idea in mind, in the classification of wild animals and species. When I consider the numerous varieties and species assumed in, for instance, the South American genus *Cebus;* when we see that every naturalist differently conceives and differently groups the numerous allied forms, the conviction obtrudes on me that we have before us a raceless multitude which oscillates between different centres, like the multitude of raceless half-tamed or wild dogs of the East, between the old pure races or species.

But when we consider the conduct of the so-called species and races on the whole, we constantly observe an important difference, which does not prevent us from establishing some few generally valid laws. Just as there are species which remain the same in all zones and have undergone no change in the course of thousands of years, so are there again other species which, transported into other climates, are essentially transformed. The one may be said to be composed of unyielding, the other of flexible materials. In the same way do we observe species, as far as history can trace them, despite of their resemblance, dwelling side by side without intermixture, preserving the same peculiarities, without giving rise to a mongrel race. Other species, on the contrary, which at a remote period were perfectly distinct species, intermixed, produced prolific mongrels, and formed raceless masses, common root stocks, so to speak, giving rise to new races and species. Finally, there may be other species, which, though originating from such common root-stocks, departed from them, and acquiring distinct characters, became hostile to their brothers.

That similar processes take place within the human genus, and human races, I shall endeavour to show in my next lecture.

LECTURE XV.

The Tradition of Adam.—Geographical Distribution of Human Races.—Constancy of their Characters in the course of time.—Pliability of Races—Development of the Skull by Civilisation.—Degeneration of Races.—An Example from Ireland.—Modifications of Negroes in America, Yankees, Jews.—Time requisite for such modifications.—Intermixture of Races.—Differences in Prolificacy in various Mongrels.—Intermixture of White Races between themselves.—Mulattoes in South Carolina and Louisiana.—Hombron's Remarks.—Indians and Whites.—Whites and Malays.—Whites and Polynesians.—Whites and Australians.—Inferences regarding the Original Diversity of the Human Races, and the Products of Intermixture.—Direct Divine Influence, according to Dr. Sagot.

Gentlemen—As far as our traditions go, however far back they reach into the remotest antiquity, we observe that wherever peoples migrated to, and discovered unknown countries, they found human beings, who appeared to them not less strange than the animals and plants they met with. There are but few small islands which, from the nature of the soil, their distance from any country, the inhospitality of the climate, presented obstacles to habitation, and thus form an exception to the general rule. The larger islands, as well as all parts of the continents under the hottest and coldest climates, were, by navigators or conquerors, always found inhabited. Even religious legends, which have for their object the origin of mankind and the history of a privileged race, even these legends indicate that at the creation of the first pair the world was already peopled, an indication given even in the Bible. After the murder of Abel, Cain was the only child of Adam; Seth and the other sons and daughters mentioned in the Bible not being yet born. Notwithstanding this, Cain takes his wife with him in his flight and immediately lays the foundation of a new city, after having received the mark on his

forehead so that nobody should kill him. This mark could only have been intended for men, for the wolf kills also marked sheep. But where Cain could have obtained a wife, or peopled a city (at the time of Adam) must always remain a mystery, unless we assume that the history of Adam is no more than a legend intended to prove the specific excellence of the Jewish race.

I merely allude to this to show that the only fact from which we can start, is that of the original dispersion of mankind upon the earth, and the original difference of races spread over the surface of the earth. However much we may indulge in theological speculations on the origin and differences of mankind, however weighty proofs may be adduced for the original unity of the human species, this much is certain, that no historical, nor, as we have shown, geological data can establish this dream of unity. However far back our eye reaches, we find different species of man spread over different parts of the globe.

The geographical distribution of mankind corresponds more or less with that of animals, though not within such narrow limits as those drawn by Agassiz. Each race or species corresponds to the general conditions of the country, climate, and the surrounding animal or vegetable world; and the laws of distribution in general show the same shades which we find in the rest of organic nature. As there are animals inhabiting a very limited district which they never leave, so are there species of mankind who are limited to a small space. Again, as there are species of animals spread over large tracts, and enabled to support the heat of the tropics as well as the cold temperature of the north, so are there species of mankind presenting the same power of adaptation to external media. Boudin has endeavoured to show, that of all known human races there is but one, namely, the Jewish race, which can easily become acclimatised in all the zones of both hemispheres, and can maintain itself without intermixture with the native race, whilst all other European races transported from a temperate to a hot climate would in the course of time become extinct, unless supplied by immigration from the mother country, because the deaths always exceed the births. Hence it follows that, excepting a

few favoured races which, as far as is known, may inhabit the whole globe, the rest are more or less confined within certain limits which they cannot without impunity transgress. But these laws now prevailing in the physical world are applicable, no doubt, to remote periods, in which the present conditions existed; and, as the facts relating to the existence of man upon the earth teach us that the conditions were not changed, neither can the laws of distribution of the human race have undergone any material change.

Not merely the difference of races, but also their constancy in the course of time, is perfectly established. We have endeavoured to show that these characters may be traced back beyond the historical period up to the pile-works, the stone-period, and the diluvial formations. The Egyptian monuments show that already under the twelfth dynasty, about 2,300 years before Christ, Negroes had been imported into Egypt; that slave hunts had, as now, taken place under several dynasties, as proved by the triumphal processions of Thotmes IV, about 1700 B.C., and Rameses III, about 1300 B.C. There are seen long processions of Negroes, whose features and colour are faithfully rendered; there are seen Egyptian scribes registering slaves with their wives and children; even the down upon the heads of the latter may be distinguished. There are also seen many heads presenting the characters of Negro tribes inhabiting the south of Egypt, and which the artist distinguishes as such by a superadded lotos-stalk. But not only the Negroes, but also the Nubians and the Berbers, as well as the old Egyptians, are always depicted with those characteristic peculiarities which have been preserved to this day. "The peasants of the Nile valley," says Broca, "now termed Fellahs, have preserved the type of the ancient Egyptians, which is the more remarkable, as they have since the Arab conquest intermixed with the stock of the conquerors. The identity of the modern Fellahs with the Egyptians of the time of the Pharaohs has been shown by Morton by the comparison of their skulls;" and Jomard confirms this as follows: "On looking at the agricultural labourers of Esné, Ombos, Edfû, or of the district of Selséle, one is apt to imagine that the images

on the monuments of Latopolis, Ombos, or Apollonipolis Magna, have detached themselves from the walls and descended into the plains."

The same constancy of characters can be traced in the other races with which the Egyptians came in contact. The Jews are as easily recognisable as the Tatars and Scythians with whom Rameses III was at war. In the same way we observe upon the Assyrian and Indian monuments the characters of such races as still inhabit these regions, so that the constancy of race characters is everywhere rendered evident. But the example of Egypt teaches also that slight changes of climate, as well as limited intermixture, have an insignificant influence on the character of a race. For more than four thousand years have Negroes, Berbers, and Egyptians inhabited the same Nile valley, and propagated there without any essential change in their characters. At a later period there was an immigration of Greeks, Persians, Arabs, and Turks, still without changing the original stock. These conquerors added but a small percentage to the existing population, and stood to it nearly in the same relation as limited intermixture, which, by recrossing with the parent stock, is absorbed in it, or leaves only a slight residue.

Whilst thus the constancy of the natural races of mankind is established beyond any doubt, we must, on the other hand, not forget that most of them possess a certain flexibility, and show, when transplanted into different media, certain changes which are the result of their adaptation to new conditions. As it is upon this point that the advocates for the unity of the human species base their arguments, we are compelled to scrutinise the respective facts.

Let us, at the outset, remember that many races, though they remain on the same spot, are apt to undergo certain changes, the result of progressive civilisation. It is chiefly the height of the skull, and the development of the frontal region, which is thereby affected, by which the internal capacity of the cranium, and the cerebral mass itself are increased. We have already pointed out, that in races capable of civilisation, the anterior sutures remain open longer, and are ob-

literated at a later period than the posterior; the reverse being the case in races incapable of high culture. We have shown that, according to Broca, the Parisian skulls have, in the course of centuries, acquired a greater internal cranial capacity. We have further shown that the cave and stone-period skulls are unfavourably distinguished by the indifferent development of the frontal region. The height of the forehead and the skull cannot, therefore, be adopted as a permanent race character, since it may change in the course of time and give to the profile a different aspect. Food, if appropriate, may also have its influence, by rendering a people larger and more muscular. The same characters which distinguish carefully-bred domestic animals from their parent stock, may also be obtained in man by continued culture. There can be no doubt that the prosperous and wealthy classes of human society are, on the whole,. physically finer and stronger than the lowest classes, who are much exposed to misery and want. It is further unquestionable that those classes which, in successive generations, follow mental occupations, possess a greater development of the skull than the ignorant masses who are engaged in the meanest occupations. We should by no means feel surprised to hear it established by comparative observations, that the squirearchy of the Mark Brandenburg, which for centuries have had no other ambition than to wear the king's livery, possess a smaller cranial capacity than the intelligent Berliners.

In the same way as culture, wealth, aliment, and particular occupations may develope a cultured race from a natural race, so may the deprivation of such influences reduce a cultured race to its primary condition. Hunger and anxiety will do more, by adding morbid characters, which may be transmitted through several generations, until existence itself becomes endangered. I shall cite for this purpose a remarkable instance of this kind, which is quoted in the *Dublin University Magazine*:—

"On the plantation of Ulster, and on the successes of the British against the rebels in 1641 and 1689, multitudes of native Irish were driven from Armagh and the south of Down into the mountainous tract, extending from the Barony of the *Flews*

eastward to the sea. The same race was, on the other side of the kingdom, driven into Leitrim, Sligo, and Mayo. Ever since that time these people have been exposed to the bad effects of hunger and ignorance, the two great demoralisers of the human race. The descendants of these refugees can still be distinguished from their cognates in Meath and other districts. They have open projecting mouths, with prominent teeth, and exposed gums, high cheek bones, depressed noses, and present barbarism on their front. We thus see in Sligo and the north of Mayo the consequences of a two hundred years' misery upon the whole physical structure, an example of deterioration by known causes, which offers some compensation by its importance for the future, in shewing the sufferings through which former generations have passed. They are on the average five feet two inches high, big bellied, bandy-legged; their clothes a bundle of rags—thus walk about the spectres of a people in the daylight of civilisation, as representatives of Irish misery and ugliness; a people once well grown, able-bodied, and handsome. In other parts of the island, where the people have undergone no such degradation, the same race furnishes the finest models of human beauty and strength, both physically and mentally."

"Every reader," adds Quatrefages to this description, "who is any way acquainted with the distinguishing characters of mankind, will, with the exception of the colour, recognise here the character ascribed to the lowest Negroes, and the degenerate Australian tribes." And further: "These two different groups, one of which reminds us of the lowest races of Australia; and the other, which will bear comparison with any white race, are they really of the same race? We answer no. The Irishman of Meath alone represents the old stock, the surrounding media have for him remained the same, and he is unaltered. The Irishman of Flews, on the contrary, placed under different conditions, has changed, and formed a new race, derived from the old, which corresponds to the *media* which produced it. There are now in these adjoining districts two races." Thus far Quatrefages.

Let us examine this point. And, first, we must remember

that party spirit speaks here, painting the condition of the Irish in as gloomy colours as possible, and probably assuming some few ragged and broken-down beggars as the type of the whole race. But, assuming the description to be correct, it is so imperfect and defective, that we can scarcely conceive how such a cautious writer as Quatrefages can find in it a description of the Australian savage.

No person has examined such a degenerate Irish skull, and shown how far it deviates from other Irish skulls, or approaches the characteristic form of the Australian skulls. The whole description resembles as closely, if not more so, that of the semi-crétins, as they are found by hundreds in poor mountainous districts. The projecting teeth, the pendulous belly, the thick noses, puffy lips, are always the attendants on scrofula, that wide-spread disease which is produced by damp dwellings, bad food, want of care, and similar causes. That there has been degeneration in these poor creatures is unquestionable; that neglect has changed the noble horse into a little rough, thick-bellied mustang is certain; but just as by proper care the noble Andalusian horse may be developed from the mustang, so may the scrofulous Irish emigrant from Sligo to America, by proper alimentation, be made to resemble in his successors the Irishman of Meath. Nothing in the whole description proves that any of the characteristic features of the Irish or Celtic skull had been obliterated. We have, therefore, before us changes such as are experienced by civilised races, when the conditions requisite for preserving that civilisation begin to fail.

We are, however, as already stated, far from denying certain modifications in races produced either by hunger and misery, or by transplantation to a foreign climate. We simply maintain, that these changes are in most human species but trifling, that they stand in proportion to the flexibility of the race, and that most races possess so little flexibility that, on being transported to a foreign climate, they perish rather than adapt themselves to the new influences.

The first and most common influence of climate shows itself in a diminution of generative power in both sexes, which, by diminishing the number of births, even if they balance the

number of deaths, must necessarily lead to final extinction. The Mamelukes in Egypt could only maintain themselves by the purchase and importation of slaves, as their own progeny, notwithstanding all care, perished. Despite of all advantages enjoyed by English married soldiers in India, they never succeeded in rearing a sufficient number for drummers and fifers. The Dutch established in Java become sterile with women of their own race, and, if they have any children, the whole family regularly becomes almost extinct with the appearance of grandchildren. As generative capacity is the last development of the organism, which is only unfolded when all conditions of existence are present, so is it the first function which fails, and soon ceases under hostile influences. As in man, so is it in animals, many of which, though apparently in excellent health, no longer propagate in captivity. Many assertions of sterility of mongrels and hybrids, founded on experiments in zoological gardens and menageries, rest merely upon this diminution of generative power, observed also in wild species, which are very prolific in a state of liberty.

Let us now examine the changes which certain races are said to have undergone, in which transplantation into other countries has produced no diminution of generative power, and where thus the conditions requisite for the formation of a new race existed. First of all are mentioned the Negroes, who, imported into Southern and Central America, are very prolific on that continent. The Northern slave-states, Virginia and Kentucky, carry on the trade of slave-breeders, just as in our own country there are cattle-breeders. Here we have abundant materials for observation. Some authors assert, in fact, that the Negroes imported into America, in successive generations, gradually approach the white race. "The Negro children of pure race," says Reiset, "born in the Antilles, have all the characters of the Negro, but somewhat more faintly developed. The colour and the hair remain the same, but the muzzle diminishes, and in all other respects the Creole-negro approaches the white." "The Negroes of the United States," says Réclus, "have by no means the same type as the Negroes in Africa; their skin is rarely velvety, though all their ancestors were imported from Guinea. They

have no such projecting cheekbones, thick lips, flat noses, thick wool, brutish physiognomies, and so acute facial angles, as their brethren in the old world. In the course of some one hundred and fifty years they have, as regards their external aspect, passed over more than a quarter of the distance which separates them from the white race."

On summarising all these observations and adding the blanching of the skin, I must ask what are the characters for the remaining three-fourths of the distance which the Negro has yet to traverse, and whether the slight changes enumerated above really indicate an approach to the white race, or whether they are merely such changes as the Negroes undergo even in their own country with advancing civilisation? There are leaden-grey Negroes in Africa, Negroes with but moderately puffed up lips, with more prominent noses, less woolly hair and less brutish aspect, with less prominent cheek-bones and less acute facial angle, than the Guinea Negroes possess, which represent the low Negro-type in general. Though we would not maintain that all the peoples of central Africa have sprung from the same common stock, we know at least so much from the descriptions of African travellers, as to enable us boldly to assert that each of the above quoted slight changes occur as much in Africa, without any contact with the whites, without any transportation across the sea, and are developed amongst the Negroes themselves. The proof for our assertion is easily found: the extract from Pruner-Bey's article on Negroes, which we gave in a preceding lecture, confirms our view, as Pruner-Bey has only examined African Negroes in Africa. But supposing these changes to take place only in America, do these changes, upon which so much value is set, affect any of the essential features of the organisation, especially the skull and the skeleton? Have any of these gentlemen compared a slave-skull, I will not say of a hundred and fifty years ago, but one of only three preceding generations, with that of a native Negro skull? And how do these observations agree with the measurements of Aitken Meigs, who assigns to American slave-skulls less capacity than to the skulls of Negroes born in Africa?

We might say still more: was either of these observers, such

as Lyell, Reiset, Réclus, in a condition to compare large numbers of recently imported African Negroes with as many Creole Negroes, as since 1808 no more slaves have been imported into America, so that the observations were only made forty years after the above period? And finally, what guarantee have these gentlemen for the pure descent of these Negroes? We know the brutality of the slaveholders, who not only claim the *jus primæ noctis*, but also the first child, and who with detestable cruelty,* and with an utter disregard of every human feeling, recross such bastards with the black race and keep them in slavery.

The American Anglo-Saxons, or Yankees, are also cited as an instance of change of characters. "Already, after the second generation," says Pruner-Bey in Quatrefages, "the Yankee presents features of the Indian type. At a later period, the glandular system is reduced to the minimum of its normal development. The skin becomes dry like leather, the colour of the cheeks is lost, and is in males replaced by a loamy tint, and in females by a sallow paleness. The head becomes smaller and rounder, and is covered with stiff dark hair; the neck becomes longer, and there is a greater development of the cheek bones and the masseters. The temporal fossæ become deeper, the jaw bones more massive, the eyes lie in deep approximated sockets. The iris is dark, the glance is piercing and wild. The long bones, especially in the superior extremities, are lengthened, so that the gloves manufactured in England and France for the American market are of a particular make with very long fingers. The female pelvis approaches that of the male." "America," adds Quatrefages, "has thus altered the Anglo-Saxon type, and produced from the English race a new white race which might be called the Yankee race."

We have nothing to say against this; for we also believe that America dries up the skin and reduces the fat,—an effect to which all the above differences might be reduced. That the head becomes smaller, we utterly deny; the exact cranial

* The author evidently writes in entire ignorance of the real facts, and the credulity which he has here shown in believing the stories put forward by the "philanthropists" of Exeter Hall, and the absurd fictions of Mrs. Beecher Stowe, is the more remarkable, as Prof. Vogt is not given to believe without some reliable evidence.—EDITOR.

measurements by Morton contradict this assertion categorically, by showing that the skull of the Yankee is as large as that of the Englishman. Thus the alleged differences are reduced to a minimum, and are the less to be depended upon, as the Anglo-Saxon race is itself a mongrel race, produced by Celts, Saxons, Normans, and Danes, a raceless chaos without any fixed type; and the descendants of this raceless multitude have in America so much intermixed with Frenchmen, Germans, Dutch, and Irish, as to have given rise to another raceless chaos, which is kept up by continued immigration. We can readily believe that from this chaos a new race is gradually forming. The facts at hand are, however, by no means so decisive as to justify us in considering these characters as constant. We must, moreover, add that the German families, who have been settled in Pennsylvania quite as long as the Anglo-Saxons, and have kept their race pure, do not present the transition into the Yankee type, but preserve that of their stock. The so-called Anglo-Saxon race, which, in point of fact, is no real race, as no fixed type has been produced by its manifold intermixtures with foreign peoples, that so-called race has, certainly, undergone some alterations in a foreign climate, whilst the fixed Germano-Saxon race, which maintains itself with great tenacity in its old dwelling places in Germany, has not changed even in America. Here again we have that difference in the conduct of old fixed and new formed races already touched upon.

The Jews also have been cited as a proof of alteration, even though, as is here the case, the stock is kept pure. It is true we find, chiefly in the North, in Russia and Poland, Germany and Bohemia, a tribe of Jews frequently with red hair, short beard, pug nose, small grey cunning eyes, massive trunk, round face and broad cheek bones, resembling many Sclavonian tribes of the North. In the East, on the contrary, and about the Mediterranean, as well as in Portugal and Holland, we find the Semitic stock with long black hair and beard, large almond-shaped eyes with a melancholy expression, oval face and prominent nose; in short, that type represented in the portraits of Rembrandt. In Africa finally, on the Red Sea in

Abyssinia, we find a Jewish nation, which despises trade, carries on agriculture and other handicrafts, and is seemingly not distinguishable from the other peoples of the country. They themselves derive their descent from the mythical Queen Sheba, who is said to have visited Solomon, when she and her household embraced Judaism.

The Jews, it was thought, thus afford a proof of the dependence of the stock on the climate, in as much as in the North they approached the Sclavonian, in the Mediterranean the Oriental, and in the South the Abyssinian type. The proofs are, however, insufficient. On the Red Sea the Jews had settlements from a remote period where, before Mohammed, they ruled in small districts, and, contrary to their usual custom, made many proselytes. The investigations of Jewish scholars, especially those of Dr. Ascher, made in Abyssinia, have shown this conversion, but no affinity of race. All Jewish scholars agree also that both types have existed from the remotest period, so that some reduce them to the multitude of people which accompanied the Jews on their departure from Egypt, and passed with them through the Red Sea; though it is rather surprising that this rabble too (the Hebrew expression still used among the Jews) should also have been worthy of the particular protection of their own God. Thus the differences obtaining between Jews seem to result rather from original tribe peculiarities than from change of localities. Another argument in favour of this view is, that the Jews of the Oriental type expelled from Portugal, who for several centuries have been settled in Holland, have preserved their peculiarities unaltered; whilst, on the other hand, in the East, the two Jewish types lived also for centuries side by side in the same climate and conditions, and preserved their respective characters.

We must, however, as regards these changes, not lose sight of a point which seems to us of considerable importance. "It required," says Quatrefages, "scarcely two centuries to transform the Irish Celt into a kind of Australian; two centuries and a half, at most ten or twelve generations, have sufficed to change the Anglo-Saxon into a Yankee. We may thus infer the effects which numbers of centuries, hundreds

of generations, may produce in man, nay, must have produced, when the savage or semi-barbarous populations knew not how to protect themselves from the influences of the new climate, when they had to struggle against animal and vegetable nature, against the physico-chemical forces which predominated. How much more destructive must at that time have been the struggle for life than it is now for those travelling pioneers whose courage we so much admire. And how much more durable and deeper must be the traces of those struggles."

It appears to me that many facts are here confounded which ought to be separated. The struggle for existence in a new country may be deadly, because the number of deaths exceeds that of births, and then there can be no question of a change of race, for it becomes extinct! Or, again, the struggle is not so deadly, that is to say, the number of births exceeds that of deaths, and the race adapts itself to the new conditions. This is done within a few generations, when a condition is established corresponding to the altered vital condition. We have for this the clearest proofs in the domestic animals which are transplanted to foreign climates. Hog, sheep, cat, and dog have thus within a few generations, in southern climates, passed through such changes as, for instance, the Egyptian goose in Europe. After that change, which, as stated, was effected within a few generations, and the race was acclimatised, no further modification took place. And we may easily convince ourselves that it must be so. For if modifications are requisite to live in a foreign climate, these modifications must be rapidly accomplished to preserve the race from threatened destruction. If then, we say, that a race which has undergone modifications within a few generations, must for that reason undergo a corresponding sum of alterations at a subsequent period; if we were to establish a quasi rule of three, and say: since this, this race has within three generations experienced x alterations, consequently it must within thirty generations have undergone $10\,x$ alterations, as Quatrefages would put it, we commit a scientific error, and excite hopes which can never be realised.

We thus infer that all instances which have been cited of changes in races of pure descent, by the mere influence of

changed media, emigration into foreign countries, etc. are insignificant, and do not affect the essential race-characters. These modifications, therefore, which we by no means entirely deny, do not in any way explain the differences in the human species. As we, always in accordance with the facts, must assume a fundamental difference of races as our starting point, the crossing question now presents itself. Here, as with domestic animals, the question was simply answered by the statement, that all races of mankind can interbreed, and that their mongrels are indefinitely prolific. But on closer examination it is found that the same conditions present themselves as in other animals, specially domestic animals; namely, that there are crossings which are sterile; others in which the bastards are but little fertile *inter se*, but more so with the parent stock; and again, there are others which are between themselves indefinitely prolific.

There can be no doubt that the various white races which have intermixed in Europe and Asia are infinitely prolific. Though by close examination we may, from this commixture, pick out the original stocks of which the civilised peoples are composed; still all European peoples are more or less intermixed, the proofs of which glimmer forth from beneath their respective characters. Now these populations of Europe increase everywhere; but nowhere do we find a pure unmixed stock or race; it thus admits of no doubt, that the mongrels of the white race are indefinitely fertile.

It is not quite so in the commixture of races more removed from each other. The connections of Whites with negresses are fruitful, and their issue—the mulattoes—are prolific both between each other and with the parent stock. It is true that race prejudices interfere with the connection of mulattoes between themselves, as the mulatto woman prefers rather to be the concubine of a white man than the wife of a black, and considers it an honour to have a child by a white man; whilst, on the other hand, the mulatto spares no effort to obtain a white wife, and only returns to the black parent stock by compulsion. Thus it comes to pass that, in speaking of mulattoes, we find only the mongrels of the first blood, for by recrossing

they are ultimately absorbed in one of the parent stocks. It might also, taken strictly, be boldly asserted that there exists no proof for the infinite prolificacy of mulattoes between each other; and it might even be maintained that they or their descendants must necessarily be sterile between each other, inasmuch as nowhere can successive generations of such mulattoes be shown to exist. It would, indeed, be difficult to find in any country a single instance of grandchildren of a mulatto by pure inbreeding; whilst, on the contrary, the mongrels, by recrossing, exist in all possible gradations, so that a number of terms have been invented in transatlantic countries to designate these crossbreeds.

The connections between negro and a white female seem to be less prolific, for anatomical reasons, which appear to be well founded. That they are productive at times there is no doubt, but the cases are so rare, that we possess no facts as regards the bastards so produced.

The distribution of the parental characters in Mulattoes and human mongrels in general, seem to differ as much as in animals. Sometimes the Mulattoes resemble more the White, and sometimes more the Negro. Thus Lislet-Geoffroy, the mathematician, though the son of a Frenchman and a Negress, presented physically nearly all the characters of the Negro. Quatrefages tells a story of a black servant who had married a white woman, and found on his return from a journey that his wife had given birth to a child so white, that he would not acknowledge it until the midwife showed him some black spots on the body. A Doctor Parsons, who saw the child, authenticates this case. It is very probable that neither the father nor the Doctor had ever seen a new-born Negro child, and were therefore not aware that the dark colour is only gradually developed.

Some American authors assert that they have ascertained a difference in the fertility of the Mulattoes, according as the white fathers belong to different stocks. Nott observes that in South Carolina the Mulattoes are shorter lived and less fit for hard labour than the Whites and the Negroes; that the Mulatto women are very delicate and subject to many chronic

diseases; that they are bad wet nurses and frequently miscarry; that their children die young, and that the Mulattoes are less fertile *inter se* than with their parent stocks. But Nott found subsequently that these inferences, though correct as regards South Carolina, did not apply to Louisiana and the banks of the Mississippi; hence he concluded that the Latin races of Europe produced with the Negro race mongrels more viable than the Anglo-Saxons. This fact seems also to have been established as regards Jamaica, colonised by the English, for the Mulattoes do not seem to thrive there, whilst on the islands colonised by the French, Spaniards, and Portuguese the Mulattoes show the same vitality as in Louisiana. Attempts have been made to explain these differences from local influences, but it would be very strange if the English should, by mere chance, have chosen such spots as are destructive to Mulattoes, whilst the Latin races should have selected those districts which are favourable to their development.

It may happen, that in the intermixture of certain races, the prolificacy is increased in the same degree as in the inbreeding of half- and three-eighth hares. Hombron, cited by Quatrefages, observes on this point: "During the four years which I passed in Brazil, Peru, and Chile, I amused myself with observing the curious intermixtures of Negroes with the natives. I have even noted down the number of children in many households, of Whites with Negresses, Whites and American women, Negroes with American natives, and Negroes *inter se*. In our colonies the Whites are only moderately prolific with Negresses; they are, however, very prolific with Mulatto women, and so are Mulattoes *inter se*. I can affirm that the marriages between European men and American women furnish the greatest average number of children; then come Negro and Negress; then Negro and American female. The scanty fertility of Americans between themselves depends probably on the moderate development of their sexual instinct." The latter reason, by the way, means as much as if we were to say that the reason why the Arabs drink so little is that they feel but little thirst. The intercourse of the Latin race with the Indian seems to be remarkably fertile; for the

South American States, almost exclusively populated by Spaniards and Portuguese, are now chiefly inhabited by a mongrel race, the issue of that intermixture. These mongrel races may certainly be partly considered as perfectly raceless masses. No constant type has as yet been formed, probably because there is a continuous re-crossing with either of the parent stocks and their direct descendants. But we should not feel surprised to see a new race gradually developed, which might be compared to the hare-rabbits. That these cross-breds of Indians and Whites are not wanting in culture, and, in certain respects, are superior to the aborigines, as well as the Creoles, is best shown by the present war in Mexico, where the Republic, under the leadership of a mongrel (Juarez), offers a heroic resistance to a well-disciplined army.

We know but little concerning the intermixture of European nations with South-Asiatics and Malays. Despite the great number of connections between the Dutch men and Java women, which generally prove fertile, and the products of which are called "Liplaps," no mongrel race has been produced; as little as in India, so that in both colonies the belief prevails that these mongrels become sterile *inter se* in the third generation.

The fertility of Europeans with Polynesians is attested by the history of Pitcairn island, where from a few English sailors and some Tahitian women a small mongrel race of about two hundred individuals originated, who are favourably distinguished by bodily conformation, muscular power, and intelligence. But this instance is to some extent invalidated by the circumstance, that even upon islands where there is much intercourse between ship-crews and native women no mongrel race has been formed, whilst the natives themselves diminish and apparently approach extinction.

The connections between whites and Australian females seem to be the least prolific of all. According to Broca, only a single bastard has been mentioned by many travellers. Whilst the terms designating in America the numerous cross-breeds form no small vocabulary, and whilst the English in Australia and New South Wales have a number of nicknames for the varieties of white colonists, there is no term

indicating the cross-breed between European and Australian, nor is there any administrative law as regards such bastards. "We may therefore," continues Broca, "assume it as a fact, that cross-breeds of Europeans and native Australian women are very rare. This fact is so much opposed to the usual theory of the interbreeding of human races, that it is worth while to examine whether there may not be other than physiological causes for it." Broca then shows that sexual intercourse between Europeans and Australian women, so far from being rare, is, on the contrary, very frequent, for the simple reason that there are but few European females; he further proves that the bastards are not, as has been asserted, killed, and that, in spite of numerous connections of this kind, there exist so few mongrels, that we possess no information concerning their physical and mental characters, and their prolificacy. In the presence of such facts, we cannot be surprised that this degree of sterility occurs in such races as, both by physical conformation as well as by distance, are far remote from each other. The objections to these facts by Quatrefages are so weak that they require no refutation. Even if it were true that the Australians kill the bastards who with their mothers return to their tribe, it might at the same time be fairly assumed that all European fathers, who produce children with Australian women, are not such monsters as to expose them to certain death. We cannot suppose such an abnegation of every human feeling to have existed even among the first criminal population of Australia.

In now casting a retrospective glance at the changes produced by external influences and by intermixture in the various races inhabiting the globe, we arrive at certain conclusions which may be fairly inferred from the facts at hand.

1. The differences in the human genus which we may designate either races or species, (both terms appear to me as regards natural races perfectly identical), these differences are, as far as we can trace them, original and have in the course of time been transmitted unchanged upon the same soil.

2. The changes, which these original species can undergo by external influences of any kind, are so slight that they cannot be compared with the primary differences.

3. The raceless masses produced by transportation into a foreign climate may, by pure imbreeding, give rise to a new human race or species, the characters of which might, indeed, become fixed after a few generations, but would require a very long period of time before they can acquire that constancy which distinguishes the original species of mankind.

4. The various species of mankind present in crossing different degrees of fertility. Most of them are between each other indefinitely prolific, as also are their descendants; in some the fertility is so limited, that no mongrel race can be produced by them.

5. The mongrel races gradually attain by inbreeding that constancy of characters which distinguishes the original race, so that from this commixture new species may arise.

6. Heterogeneous races have by intermixture given rise to raceless masses—peoples which present no fixed characters, and form, so to speak, dispersive circles around the original species, which at their points of contact become confluent.

I cannot deny that these views are not exclusively derived from what is observed in man, but chiefly from what is seen in domestic and wild animals. But this, if I am not mistaken, gives greater weight to them. We are not so blind as to maintain, that the original species of mankind can undergo no change by the influence of surrounding media. We neither deny intermixture nor the mongrel races to which it has given rise, but we are unable to perceive that their existence can entirely obliterate the original difference, or afford a proof for an original unity, which is opposed to all known facts. Again we neither deny the disappearance and extinction of well characterised races, nor the rise of new races and species from the commixture of existing species, intensified perhaps by the influence of external media. All this is confirmed by the facts observed in the rest of the animal world. For the development of this view we certainly as little require supernatural influences, or direct interference of foreign forces, as Laplace required a divine interference for celestial mechanics, an hypothesis which a modern pious defender of the unity of species, in the face of all facts, advances in this manner :

"I am of opinion that during a period, probably of several centuries, after God had multiplied the languages, separated the various tribes which spoke different languages, and distributed these peoples over the surface of the globe, He endowed in the course of generations each race, as it became a nation, with a peculiar external character. In appointing to each stock a dwelling place, God also endowed it with a capacity to live either in the arctic, temperate, or torrid zone; He also taught them, or assisted them, in their invention of means to satisfy their wants, and finally presented them with useful plants proper to the climate, and which do not grow wild."

This is the explanation of Doctor Sagot, who in this manner reconciles the diversity of mankind with Biblical unity. If God really fed the animals in the ark of Noah with food from heaven, all difficulties are at an end. If all natural conditions and facts which oppose a myth are to be removed by a direct divine interference, natural science is useless. We have not arrived yet at this point in the civilised world, although some eyes are turned in that direction.

LECTURE XVI.

Origin of Organic Nature.—Differences between the Organic Kingdoms and their sub-Divisions.—Origin of Organic Cells.—Theory of Darwin.—My change of Opinion.—Creation of Species.—Mutability of Type.—Consequences of this Theory.—Adaptation and Fixation of Types.—Practical Conception of Species.—Variation in Adaptation and Slowness of Transformation.—Present and Former Transition Types.—Cebus.—Bears.—The Greek Monkey of the Tertiary Period.—Exclusive Views of Cuvier and Agassiz.—Rarity of Transition Forms.—Progression and Retrogression.—Fundamental Plan in the Structure of Animals.—No single Original Organic Form.—Derivation of the Human from the Ape-Type.—Derivation of the three Anthropoid Apes from three different Families.—The various original Human Races must be derived from different Ape Families.—Lamentations of Moralists.

Gentlemen,—The desire of man to inquire into the origin of all things produces daily fresh attempts of ascending the scale leading in that direction. Faith has in this respect an easy task; it builds upon some old myth a system which points to an unknown beyond. The path of science is more rugged, as it must steadily keep to the principle, not to depart from the facts and the limits fixed by observation and experiment. The further back science proceeds, the more necessary is it to use caution in drawing inferences from the facts, and the greater should be the candour in confessing the gaps which are every where met with; not for the reason that no created being can penetrate into the sanctuary of Nature, but simply because the facts and observations are so numerous that they cannot be mastered by one individual.

The origin of organic nature has always attracted the attention both of the professional naturalist and the general student. Observation teaches that every organic being owes its origin to parents, which are again the product of other parents; no where is there an interruption in the series, so that notwithstanding all assertions to the contrary, the production of organic beings from original elements has hitherto failed. However

glad, to tell the truth, I might be to accept the theory of spontaneous generation; however illogical it appears to me to assume for the production of organic beings a special force in nature, which we observe nowhere else; however natural it may be to search in this primeval generation for the starting point of organic creation, which might then have developed itself in various directions by the influence of various causes; I must on the other hand confess, that only the most stringent proofs could induce me to adopt it. If this be forthcoming I shall accept it most willingly; till then, I must acknowledge the existence of this gap in our science, though I entertain the hope that we shall finally succeed in filling it up.

Organic creation, considered in its totality, presents a remarkable diversity. The chief kingdoms of nature, the vegetable and animal kingdoms, appear sharply separated from each other. Even within these kingdoms there are some divisions so dissimilar in structure and fundamental plan, that again we imagine a gulf to exist between them. It is, however, soon perceived that there are some groups which have a closer connection; that the similarities of structure grow out during the development of the individual; that the groups related to each other proceed from a common fundamental form, from which these diversities very gradually arise.

It was no small triumph for microscopic science when Schwann proved that all the tissues, whether vegetable or animal, owe their origin to certain elementary forms which he called cells,—a fact now generally admitted. There exists at present no doubt with regard to the development of every vegetable or animal organism from a single cell,—from the egg. There are organisms, both vegetable and animal, consisting of one cell only, which is endowed with all capacities requisite for life and propagation. All other organisms, however complicated they may be, are merely masses of cells, differently shaped and grouped, and have all been developed from one primordial cell.

Whilst thus the unity of the fundamental plan in the structure of the vegetable and animal world is no longer doubtful; whilst it is manifest that there are a number of primitive organ-

isms which occupy an intermediate position between the vegetable and animal world, and thus apparently constitute a connecting link between the two kingdoms, we must, on the other hand, not forget that "cell" is only an abstract notion, and that there prevail many diversities in the individual cells of the various organisms and their respective organs—differences which must be considered as original, and which therefore from the very beginning impart to the organisms arising from them a special direction in development. If, therefore, it be said that all organisms arise from a single cell, and that this cell is the fundamental and primordial form of the organism, it is perfectly correct; but if it be attempted to reduce all existing organisms to one primordial elementary cell, from which they may have been developed, the axiom is false. Not only do organisms that stand in an intermediate position between animals and plants consist of different kinds of cells; not only are these cells developed in a different mode, so that we are able to distinguish different species of these organisms; but also those egg-cells from which the more compound organisms are developed, show, from the beginning, a fundamental difference both in form and subsequent development. The attempts, therefore, to reduce the whole organic world to one fundamental form, so to speak, to one primordial cell, from which all organisms have been developed in different directions, are as futile as the assumption of those naturalists who consider that the whole organic creation had been developed from an elementary plastic matter, the so-called primordial slime. In assuming the possibility that by the co-operation of some forces—as yet unknown to us—an organic cell may be produced from chemical elements, it is clear that the slightest change in the action of these elements must effect a change in the product, that is to say in the cells produced. But as it is impossible to assume that on the whole surface of the earth the same causes have acted, and are still acting, under the same conditions and with the same intensity in the production of such elementary cells, the deduction is clear, namely, that the original cells from which the organisms were developed must have possessed diversified forms and a different

capacity for further development, so that the actual diversities were conditioned by differences in the primary forms.

In bringing before you this hypothesis,—for as yet it is no more,—I do so to prove to you that even on the assumption of a gradual development of such types, as we find both in existing and extinct species, we are not led, as so often asserted, to an original unity of the whole organic world; but that we must, on the contrary, acknowledge that in that abstract unity, termed a cell, there must necessarily have existed an original difference,—such as that existing in the organisms intermediate between plant and animal. But just in this, as appears to me, lies another reason for the assumption that the organic world might have been developed from such a beginning. If it be difficult to conceive how the great diversity of organic types could have been developed from a common soil; it can, on the other hand, not be denied that an intrinsic difference in the constitution of this soil may have given rise to the diversities of the types sprung from it.

The theory of the gradual development of types from primarily common forms, has recently, with much ingenuity, been advocated by Darwin, after it had been formerly advanced by French and German naturalists, and especially by Lamarck, though in a different form. This theory, as then advanced, certainly found in me a violent and sincere opponent; but as it is now propounded, I must confess that it appears to me to afford, better than any other theory, a clue to the affinity of individual types, and it seems in every respect a step in advance towards the knowledge of truth. When I opposed the doctrine of the gradual transformation of types, I was certainly much prejudiced by received opinions, which obtrude upon anyone engaged in scientific researches. The sharp contrast apparently existing between species, the systematic distribution and strict division of the different groups, must necessarily have a similar influence upon a young student, as that produced by the contrasts which he finds in living characters. And just as in daily life we gradually become convinced that there exist no human beings absolutely good nor absolutely bad,—that life and society oscillate be-

tween two extremes, ; so do we find, in the investigations of the forms of the animal world and their development from the egg, that here also the contrasts diminish, and that there exist a number of forms which may well have been derived from each other. Isidore Geoffroy Saint-Hilaire has pointed out how the views of Buffon, as regards the limits and fixation of the conception of species, gradually changed ; how, at first, he ventured upon a hard definition which admitted of no flexion, and how he gradually adapted it to the facts which he had gathered through life, and which he was wise enough not to reject because they clashed with his theory. I also lay claim to the benefit derived from continued self-instruction, as regards the change of my opinion.

Darwin endeavours to show that every animal and every plant sustains a constant struggle for existence, that it has to contest for space, aliment and propagation, not only with the surrounding physical agents, but with the whole organic world, in which every other individual has the same rights to space, aliment, and propagation. Every germ, every egg, has a claim to life, but not every egg is developed, nor every germ unfolded. Most succumb in this struggle, some sooner, some later; that individual only, which by itself or by association is strong enough to issue from this battle as victor, is enabled to live and to enjoy life.

The question now arises, whether an adaptation of the individual as well as of its progeny to the conditions of existence can take place ? The question is, whether this adaptation by continued improvement, continued breeding, if we may thus express it, can lead to transformations which may compel us to acknowledge these products as new types. On this point most naturalists differ in opinion.

The prevailing opinion, hitherto, was, that species are fixed normal types, which may undergo changes within a very limited sphere ; that they were the expression of a definite realised idea ; that they were the separate unchangeable materials from which, according to a creative plan, the structure of the organic world had been erected. It was also asserted that species can indeed perish, but cannot be transformed; that from time to

time the organic world is destroyed, after which a new creation takes place after an improved plan by a divine "*fiat.*"

I have already stated that the idea of a Creator, who from time to time destroys the furniture of the earth, and supplies a new one, was repugnant to my notions. I said No! I cannot believe this. But as I had no better theory to offer, I was obliged to confess, like Künöl, the professor of Theology at Giessen, who, having lectured for a fortnight on the resurrection of Christ, during which time he had exhausted the manifold hypotheses of theologians on that subject, concluded as follows: "To tell the truth, gentlemen, I must confess we know nothing at all about it."

Darwin starts from the mutability of types. He instances not merely the domestic, but also wild animals and plants in support of his theory. In the struggle for existence, he contends, every animal must endeavour to attain that relative perfection which enables it to sustain that struggle. The transmission of characters, which is undeniable, and even that of individual characters, which is also established, renders it possible that such peculiarities, which are advantageous to this struggle, may also be transmitted to, and further developed in the offspring. There thus arises a breed by natural selection, which in some privileged individuals acquires a particular fixed type. In this manner, that is to say, by continued and uninterrupted transmission arise new varieties, races, and species; and as this transformation process is continued through long periods of time, the production of such natural selections may, at last, so much deviate from each other, that they represent genera, families, orders, classes, and kingdoms.

It is not surprising that Darwin's theory, of which I have given you but an imperfect sketch, has excited much opposition. Coarse attacks were directed against this naturalist, the author of sterling works. At present, the opponents have given up refuting; for as there is much in this theory that cannot be refuted, they confine themselves to calling Darwin's theory a dream, an ingenious hypothesis, a dazzling firework, and think they have done for a work fraught with such momentous consequences.

These consequences are certainly formidable in some respects. There can be no doubt that Darwin's theory ignores a personal creator, and his direct interference in the transformation and creation of species, there being no sphere of action for such a being. Given the first starting point—the first organism—all existing organisms are subsequently, by natural selection, developed from it in a continuous manner through all geological periods by the simple laws of transmission. There arise no new species by any creative interference; none disappear by a divine mandate of destruction, since the natural course of things, the process of development of all organisms and of the earth is amply sufficient for the production of all these phenomena. Even man is neither a distinct creature, formed in a special manner, and differently from all other animals, nor provided with a special soul and endowed with a divine breath of life—he is only the highest product of a progressive natural selection, and descends from the simious group standing next to man.

Darwin, it must here be stated, has nowhere in his work touched upon these sequences, so that from the richness of materials, and the logical treatment of the leading idea, the work met at first with a very favourable reception in England—a country so much attached to Biblical traditions. But when it was perceived upon what base the theory rests, the storm broke forth from all quarters of the compass; nor has the agitation as yet subsided. But we must not be disconcerted by attacks of this kind; let us then pursue our investigations.

If it be once established, that species may generally successfully intermix and produce prolific mongrels; if, on the other hand, it is ascertained that for their adaptation to surrounding conditions they may undergo changes, the limits of which are not yet determined, there are two ways open in which new forms may arise. There exists no doubt a conservative element in the fixation of characters in unchanged external media, otherwise the transformation would be infinite for every type. Darwin has, perhaps, taken too little notice of this element, as his chief object was to establish mutability, which hitherto had been denied.

We have seen that the notion of 'species' neither is nor can be fixed, and that practically every author conceives it differently. Any one who has seen the conchological collection in the Paris *Jardin des Plantes,* must have observed twenty or thirty species ticketed as races or varieties, which in the British Museum are arranged as well characterised independent species. Each of these scientific institutions defends its own theory on apparently sufficient grounds. The one points out the transition forms; the other the distinctive marks in these forms. But this is not the only instance in which naturalists differ; and in approaching man, I shall here touch upon the ape. By the side of some well characterised species, about which all are agreed, there are others, *e.g.* the capuchin, the brown Cebus, the howling monkey, and even the orang, which by different authors are divided into dozens of species; so that it may be asserted that *the views as regards the specification of monkeys disagree quite as much as those concerning that of mankind.* Here, therefore, the principle of mutability must play an important part, and there must exist a series of forms which stand in the closest relation to each other. All naturalists admit, that species occupy only a limited sphere of distribution, which may be wider or narrower, and within which they arrive at the greatest perfection; but that at the boundaries of these spheres, these species degenerate, that is to say, assume other forms in order to adapt themselves to altered conditions. That this mutability might go much further and transgress the limits usually drawn for species, we have already shown in the races of domestic animals, which are in fact species.

From the same example we have also learned that when the surrounding media are unchanged, the production of new species can only be effected by intermixture of allied species. At first, the issue of such commixtures will be raceless masses, the characters of which have no particular constancy; but by degrees fixed characters are evolved from such masses, which produce a constant race,—a typical species.

It is clear that so long as the surrounding media remain the same, a typically fixed species will experience but little change,

but will have its characters more fixed. It hence is explained that the old species, the relics of which we find in the alluvium, and the species which existed 5,000 years ago in Egypt, the mummies of which we find in the graves, have not changed since that period, but represent the same types now as then. Just as there are species which in the present creation are scattered over a considerable tract of inhabitable climates, and which for their acclimatization require only insignificant modifications, so are there types, which during geological changes have remained unaltered till the present period. The genus *Lingula* has thus been pointed out, as having remained unchanged since the deposition of the oldest Silurian beds to the present period, and as being represented in almost all strata by several species differing but little from each other. Here we find a remarkable constancy, but I cannot look upon this as a proof against Darwin's theory. The error is constantly committed of applying the conditions found in some species to the whole animal kingdom, and forcing it into a strait jacket which the variety in nature does not tolerate. Though the mutability and adaptation to external conditions be a possibility, it is no absolute necessity for all types, as little as the number of these changes, requisite for adaptation, is the same in all types. We know that some species cannot be acclimatized at all, others are easily acclimatized: some cannot undergo the slightest change without perishing, while others experience important alterations before they become adapted to the new conditions. And so, in the history of the earth, there must necessarily exist similar differences, inasmuch as certain species and types last only short periods and then perish; others keep pace with the changes of surrounding media, and undergo comparatively great alterations. Others, again, require only insignificant modifications for their preservation.

Although the changes which we now observe in creation are inconsiderable and insignificant, we must not forget that the history of the earth extends over a series of ages of which we have no conception, and that this eternity (for we cannot term it otherwise) comprises an immense series of changes,

carried on slowly, but which, in their totality, exceed anything we are able to observe within the span of time open to our view. The upheavings and subsidences of continents, the altered proportions of land to sea, the gradations of climates, in short, all changes on the surface of the earth made known to us by geology, have not been effected by sudden convulsions, but have been gradually and impercepibly produced. The changes in the animal world have proceeded *pari passu*, and while many inflexible races have perished, others have been transformed, and thus present a series of changes, the terminal points of which deviate so much, that families, orders, classes, might have issued from them.

It has long been acknowledged that the actual creation represents by no means an ideal whole, the members of which are harmoniously connected, and that it can only be considered in its *ensemble* by including the extinct animals. What in the present animal world appears as perfectly distinct becomes cemented by the transitions represented in extinct animals, so that every new discovery adds an intermediate link in the series of forms. Just as in the external animal world, no definite boundary-line can be drawn between fishes and amphibia, inasmuch as the genera *Lepidosiren* and *Protopterus* present the most evident transitional forms, so that, according as a naturalist considers this or that character the more essential, they are by one author included in fishes, by another in amphibia, so it is with a multitude of transitional forms found among organic remains. The boundary-line between amphibia and reptiles, which may be drawn in the present creation, no longer exists when we look at the singular family of Labyrinthodonts, which extends to both. The boundaries between herbivorous Cetacea and Pachydermata, between these latter and ruminants, are removed by the *Dinotherium* and the *Dichobune*. The feathered reptile* of Solenhofen indicates that nature is able to bridge over the gulf between reptiles and birds. The existence of these transition forms is undeniable —their significance does not consist merely in the filling up of

* Proved satisfactorily to have been a bird with a long series of caudal vertebræ.—EDITOR.

an ideal gap, but in the establishment of real intermediate forms, which, by gradual unfolding and transformation, develope themselves from lower forms and approach the higher—an approximation which here succeeded only up to a certain point, but is accomplished in the more perfect forms.

But, we are told, these intermediate forms certainly fill up the gap between great divisions, but the minuter transitions, which might teach us the process of this transformation, are entirely wanting. We ought to be able to trace these transitions step by step, both in living and fossil species. As regards living species, this would not be very difficult. Place side by side the skulls of the various species of the genus *Cebus*, and see whether you cannot establish a perfect series of minute changes in form, as in dogs or cattle. The transitions are then rendered as evident as they are in a series of Orang skulls of different ages in the extreme forms of the round young head, and the long extended head of the old orang. With regard to fossil skulls, need I instance those of bears? The great cave-bear, with its prominent brow-ridge and its convex elevations on the forehead, is certainly, as A. Wagner has shown, a distinct species, just as our present brown bear; but are there no intermediate forms, such as the *Ursus arctoideus*, which, though it attains the size of the cavern-bear, has neither its frontal eminences, nor such thick bones? then there is the *Ursus Leodiensis*, which is smaller than the cavern-bear, aud shows no such frontal eminences; there is also the *Ursus priscus*, smaller than the cave-bear, but resembling in profile the still smaller brown bear; and finally the brown bears found in the caverns of Switzerland, the skulls of which show a gigantic size, approaching that of the cave-bear. All these transitional forms are very rare. We possess only a few specimens of each, whilst skulls of cavern- and of brown-bears are collected by hundreds. The large, savage, and formidable cavern bear corresponds with the conditions which surrounded him, in the same manner as the living brown bear corresponds with existing conditions. The transition from the cave-period to the present, perhaps, took place within a comparatively short time, consequently the transitional forms, indicating the raceless oscillations between two fixed types, are very rare, compared

with those extreme forms which we acknowledge as independent species.

I hasten to another example, which concerns us more particularly.

Cuvier never had an opportunity of seeing a fossil monkey; at that time there had not been a fragment of one found. Even on theoretical grounds, Cuvier contested the existence of fossil monkeys. "At present," says Albert Gaudry, "we know, besides those found in Greece, ten other species: two from South America, three from Asia, five from Europe (where at present no monkeys exist). All these species have been determined from very imperfect remains, the bones being very rare. In Greece the fossil monkeys are more abundant. The excavations I was commissioned to make by the Academy produced twenty skulls of these animals, several jaws and bones of different parts of the body, so that I was enabled to compose a drawing of the whole skeleton." After quoting the remarks of A. Wagner, the first discoverer, and those of Lartet and Beyrich on the fossil monkey, which Wagner considered as an intermediate form between *Semnopithecus* and *Hylobates*, he continues: "My last investigations had a remarkable result; they prove that the limbs of the Greek monkey differ greatly from those of the *Semnopithecus*. The Greek monkey (called *Mesopithecus*) resembles in its skull the *Semnopithecus*, but in its limbs the *Macacus*.

"This is a perfectly transitional type, which connects two genera perfectly distinct in the present creation. When we had before us, not merely a fragment of a jaw (as is the case of most fossil mammals registered in the catalogues), but perfect skulls, we were apt to believe the Greek monkey a *Semnopithecus*. This was an error. Had we, on the contrary, had before us not a single bone but all the bones of the limbs, we might have assigned them to the *Macacus*; this also would have been an error."

I repeat with Gaudry: Is this not a perfect transition form between two distinct genera, the head a *Semnopithecus*, the body a *Macacus?* We know not whether this new species, which in Greece abounded in the tertiary period, was developed

from the crossing of both elements, or perhaps by natural selection; no person can decide how this form arose; but that the intermediate form exists in such a shape that it might have been the result of cross-breeding cannot be doubted. That this race acquired the requisite capacity for existence is rendered evident by its frequent occurrence in a country where at present no monkeys exist, where, therefore, by subsequent changes in the surrounding media the existence of these animals was rendered impossible.

There exist thus intermediate forms of minute transitions and regular transformations. The example of the Greek monkey shows that the whole structure must be known, and that it is not sufficient to study the skull or the dentition to detect such intermediate forms, and that for this reason our knowledge of fossil forms is too fragmentary for us always to find them out.

We are certainly told not to make deductions from the unknown. I agree with this perfectly. I do not assert that because an intermediate form has been discovered between *Semnopithecus* and *Macacus*, there must be one found between the *Semnopithecus* of the old world and the *Cebus* of the new; but I also maintain, that in our fragmentary knowledge we must not, where our knowledge is for the moment at fault, say, thus far and no further! It is scarcely thirty years since Cuvier said: There exists no fossil monkey, and none can exist: there is no fossil man, and there can be none; and yet to-day we speak of fossil monkeys as of old acquaintances, and trace back fossil man, not only to the diluvium, but to recent tertiary formations, though some obstinate persons still assert that Cuvier's principle cannot be controverted. It is scarcely twenty years since I learned from Agassiz: Transition beds, palæozoic formations = Empire of Fishes; there are no reptiles in this period, nor could have existed, as it would have been contrary to the plan of creation. Secondary formations (Trias, Jura, Chalk) = Empire of Reptiles. There are no mammals, nor could be, for the same reason as above. Tertiary strata = Empire of Mammals; there are no human beings nor could have been. Present creation = Empire of Man. Where is at present this exclusive plan of creation? Reptiles in the Devonian strata, reptiles in coal; farewell then Empire

of fishes! Mammals in the Jurassic formation, mammals in the Purbeck limestone, which some consider as belonging to the lowest chalk. Adieu, then, Empire of reptiles! Man in the upper tertiary strata; man in the diluvium; good-bye Empire of mammals!

The proof of one well-attested transitional form includes the possibility of all other transitional forms, but not their necessity or actual existence.

I must now draw your attention to another point rendered evident by these examples. The transitional forms between the two bear species with fixed characters—the cave bear and the brown bear, are as rare as the two species themselves are abundant. One portion of them seems also to have been intermediate in time, since the colossal brown bears from the Alpine caverns of Switzerland are more recent than the cave-bear, which is, according to Wagner, also the case as regards the *Ursus priscus*, whose head is found along with the lower jaw, and thus probably deposited by standing water, whilst the cave-bear skulls are never found so connected. But apart from this circumstance, we must notice the rarity of such transitional forms. There is no doubt, if the change of surrounding media occurs within a comparatively short time, the transformation of the type must keep pace with it. We have alluded to this when speaking of the domestic animals introduced into South America. The modification of type experienced by cats in Paraguay, swine in Chile and the Brazils, and the sheep in the same regions, in consequence of a sudden transplantation, were effected within a few generations. The transformed type was soon adapted to the climate, and has now assumed a stationary form. Unfortunately our knowledge refers only to the exterior, and notwithstanding the great interest attached to this question, no naturalist has yet compared the skulls of the European domestic animals, acclimatized in South America, with those of the parent stocks bred in Europe. Admitting that striking differences do exist, that the skull of the swine, for instance, has become shorter and higher, the snout thicker, the tusks more curved, so that the South American domestic pig represents, even in the skeleton, a new and easily distinguished species. Admitting all this, where do we find the transitional form which led to this result?—Nowhere! The millions

of cattle, horses, and pigs which now populate the extensive tracts of South America, either in a wild or semi-domesticated state, are, as is historically proved, the descendants of some few imported specimens. The first generations, now found in small numbers, had to struggle for their existence in the foreign climate until the acclimatization process was completed. Only after the race has been brought into harmony with surrounding media does it begin to multiply rapidly; only when it has become typical does the number increase up to millions. But as to the transitional forms of the few individuals of few generations, where are we to find them? Who is to disinter them from the soil? The two species, the original and the derived, are not apparently linked by an intermediate form, as nobody can show them; yet they did exist, for the transition has taken place within historic times, and is historically authenticated.

Is the process different in wild animals? Let us assume that the transformation of the bear has taken place during the glacial period, which, as we have shown, was only an incident of the so-called diluvial period. There is no doubt that most of the cave-bears perished by the advance of the ice, which deprived them of their means of subsistence, and prevented their emigration into other regions. But some few of these animals were preserved; their successive generations adapted themselves to the new conditions; their wildness diminished; their means of subsistence changed, and they became smaller in size, until the change was effected and the cave-bear transformed into the brown-bear which, now adapted to the new external conditions, multiplied greatly. But the transitional forms—the witnesses of the fierce struggle for existence during changing conditions—must they not be far less numerous than the typical species which form the terminal points of this struggle?

Thus it will always be, if the surrounding media change within a comparatively short time. The transitional forms reduced to a few individuals, will, among the number of typical species adapted to external conditions, disappear, and it will only be owing to a happy accident if, here and there, a specimen of them be found.

The case is altered when the changes, in consequence of geological metamorphoses, are very slow. The adaptations which these infinitesimal changes require, and which only become visible in their effects by the accumulations of thousands of years; these adaptations are as slight as the cause which produces them, and they will consequently produce such a number of gradual transitional forms that an infinite number of specimens are required to connect the extreme ends of the change. Do we not behold this in nature? Do we not see species of one group of strata slide into another; that is to say, pass through a long series of development stadia in order gradually to assume a form which differs from the original form, not sufficiently, indeed, to be distinguished under all circumstances, and yet enough to justify its distinction by the prefix *sub* (*e.g.*, *Terebratula triquetra*, and *subtriquetra*) from that found in another group of strata? Have we not seen the changes which, by the gradual elevation of Sweden and Norway, have taken place in the Fauna of the coasts? Can we forget what Lovén has shown, that by the separation of the Wener- and Wetter-lakes from the sea with which they were formerly connected, most species of this ice-sea perished, but some craw-fish have preserved themselves in these lakes gradually filled up with fresh water, and have so adapted themselves to the changed medium, that though the original type can be detected, peculiarities of form have been developed establishing an essential transformation? Does not this example show us what all investigations concerning petrifactions teach, that there exists nowhere a thorough separation between two groups of strata, but that some individual species, more or less in number, and more or less changed, pass from one stratum into another?

We have seen that fixed species may alter under changed conditions, and that this alteration of the surrounding media is an essential lever for the production of those oscillating types which pass under the name of raceless animals. We have further learned that the fixed types interbreed less readily the more constant that type. Is it not, hence, evident that the production of new mongrel races must take place

at that period when, by the change of surrounding media, the fixity of the type is broken and produces that raceless soil from which the various types spring up, partly by intermixture and partly by adaptation, in order to become again fixed types?

It appears to me that in this way may be explained both the renewal of creation in different epochs, as well as the extinction of most species at the same periods, and also the fixity of types during long periods intervening between renovation epochs, and further the development of more perfect types from the raceless masses which arise in the beginning of the renovation period. There may, in many respects, be progress, arrest, or retrogression. Thus the type of the Ammonites seems to us a more perfect type than that of the Nautilus, nevertheless the former became extinct at the end of the chalk period. The cavern-bear was more of a beast of prey than his descendant the brown bear, and this can hardly be called a progress.

Acquainted as we are with the retrogressive metamorphosis in animals, namely, how an animal may in its earliest youth have a more perfect structure than at a later age, why may we not imagine a similar process taking place during the adaptation to changed conditions which no longer permit the type to continue in its former perfection? Why should not types become gradually fixed by their adaptation to changes, and modify their sensitive and locomotive apparatus, which can no longer be used as formerly, when they moved under different conditions, by which their senses and limbs acquired a certain perfection? Modifications of this kind which, from an anatomical standpoint, must be considered as a retrogression, may, under given circumstances, be as advantageous in the struggle for existence as the transformation of the palmated feet of the larvæ of certain parasitic Crustacea into hooks and claws is advantageous for their subsequent, so to speak, sedentary life.

But whilst we thus proceed hand in hand with observation, we must not forget that transformation by adaptation, or by intermixture, is still confined within certain limits which are

impassable. Thus we see that the gulf between fishes and reptiles has been filled up; that that between reptiles and birds is beginning to fill; that some points have been gained to support a bridge over the gulf between reptiles and mammals, the more so as in all vertebrate animals we perceive a unity of structure and a similarity in the fundamental plan, manifesting itself in the unfolding of forms, as well as in the development of the stages, which the embryos of the higher animals have to pass through from the beginning of their existence until they arrive at maturity. But from the Vertebrata to the Invertebrata I can find no guide, nor have I any idea by what adaptation or intermixture intermediate forms can arise, which may lead from the Mollusca and Articulata to the Vertebrata. It is moreover well known that the lowest vertebrate we are acquainted with,—the *Amphioxus lanceolatus*, is, as regards the development of all its organs, so far behind that of the higher Mollusca and Articulata, that the transition from one of these better developed types into that of this vertebrate would include a series of retrogressions, from which nevertheless is said to have issued the beginning of a structure capable of the highest development. In other words, I see here the vertebrate type, with man as its highest development, commencing with an animal, which, as regards the perfection of its organs, is excelled by most worms, and much more so by most Mollusca and Articulata, which in some instances attain the highest development of which the structural plan of the Articulata is capable. I should thus find myself face to face with an insoluble enigma, if I were not permitted to recur to the conclusion I have arrived at, namely, the assumption of an original difference in the primary germs from which the animal kingdom has been developed.

On following the animal structure in its downward direction, we certainly find that the Articulata, step by step, reach the worms, and these again approach the Infusoria so closely, that some naturalists include the latter in the former. On the other hand, the Mollusca approach the Radiata, there being some forms which naturalists include in either of the above divisions, so that even here an original difference shews itself. These

fundamental differences cannot, in my opinion be reasoned away, nor can I comprehend their development from one original form. What I can understand is this, that each of the plans may, in its increasing simplification, be traced back to an ideal original form of organic development—the cell; and, as I have already observed, it appears to me very probable that the elementary cells have from the beginning been differently constituted, which differentiation is manifested in the development of the fundamentally different structural plan, which is recognised in the animal kingdom. I repeat, I am far from adopting either a formal original substance or one cell form as the fundamental type and beginning of the whole organic creation. As I find in the present creation animals and plants consisting of a single cell, which present a different composition, different forms, and a different mode of life and of propagation, I do not see why the primary single-celled organisms which might have arisen from the elementary substances should all have possessed the same form, quality, and capacity for development.

It is sufficient for me to have shewn that an original difference may exist by the side of modification and adaptation, that both must supplement each other in order to render intelligible the picture presented by organic nature.

Let us after this digression return to our theme, the origin of man and his descent from the ape.

The course of lectures which I conclude this day, had for its object the indication of the kind of studies requisite in order to arrive at certain results. I have endeavoured to show in what respects the organisation of man differs or agrees with that of the ape. I endeavoured to indicate the fundamental plan in the structure of the individual organs, which is evidently the same in man and ape. But whilst insisting on the identity of the plan, I pointed out the difference in its execution, in the same manner as a teacher of architecture may demonstrate the unity of the plan in several Gothic cathedrals, whilst at the same time he points out the diversity of its execution in the respective minsters. I have proved to you that the differences between some human races are greater than those subsisting between some ape

species; that, therefore, we are justified in assuming different species in mankind, just as in several domestic animals of high antiquity. I touched upon the antiquity of mankind, and pointed out the differences in the human species, which, at the beginning of the stone-period, inhabited the earth. We then glanced at the origin of new races and species, and arrived at the conclusion, that transformation, adaptation, natural selection, are processes in nature explanatory of the various forms of which the organic world consists. We may, therefore, now proceed to discuss the last question,—namely, whether the theory of the derivation of the human type from the simian group is scientifically admissible.

The existing materials for bridging over the gulf between man and ape I have placed before you. I have shown in what points the three anthropoid apes establish the similarity; in what respects the races of mankind, and especially the Negro, approach the ape-type, without, however, completely reaching it. I have demonstrated that the oldest cave-skulls known to us decidedly approach the ape-type, both by the elongated form and the low arching of the skull. I have, finally, directed your attention to the microcephali, those congenital idiots, not as constituting a separate species, as some of my detractors make me say, but as a morbid arrest of development, which indicates one of the stages which the human embryo must necessarily pass through, and which now in its abnormity represents that intermediate form, which at a remote period may have been normal. I remind you on this occasion of what I said concerning these microcephali, together with Gaudry's remark on the Greek monkey. Just as Gaudry observed that the whole skull of the Greek monkey would constitute it a *Semnopithecus* had not the limbs been found, which present the type of the macacus, so, I remarked, might the skull of a microcephalus, found in a fossil state, in the absence of the jaws be mistaken for that of an ape, until the discovery of the limbs should establish the human type. But as it is certain that the microcephalus, with his arrested development, is not suited for propagation, it is neither the only possible nor the only imaginable intermediate form between man and ape. But this arrest which the brain experienced in its forward march, is the simian stage. This abnormal creature, this arrested

monstrosity of the present creation, fills up the gap which cannot be bridged over by normal types in the present creation, but may be so by some future discoveries.

We are told that intermediate forms have not been found, and we admit this. But when it is added that none can be found, the history of the last ten years, with all its discoveries relating to man and the ape, tells a different tale. Twenty years ago fossil monkeys were unknown, now we know nearly a dozen; who can tell that we may not in a few years know fifty? A year ago no intermediate form between *Semnopithecus* and *Macacus* was known, now we possess a whole skeleton; who can assert that in ten, twenty, or fifty years we may not possess intermediate forms between man and ape?

But whilst we assume the actual descent of the human race from the apes, and believe that the differences between both, which will become greater by the further development of man, are the result of selection and intermixture, we must, on the other hand, decidedly repudiate an inference we are charged with, and which consists in this, that we must necessarily come back to the original unity of mankind, and consider Adam as an intermediate form between ape and man. "The changes in the history of science," says Councillor R. Wagner, "have a remarkable, almost comic, aspect, when we look at the fierce contest now raging between mono-genists and poly-genists, as they call in France the advocates for one or many parent stocks of mankind. Three years ago, just before Darwin's book appeared, the theory of the possibility or probability of the different races of mankind having descended from a single pair was considered as perfectly antiquated, and as having lagged behind all scientific progress, whilst now, to judge from the applause with which Darwin's theory is received, there is nothing more certain than the inference that both ape and man had for their single progenitor a form intermediate between ape and man."*

We crave pardon, Sir Councillor; never was there a more incorrect inference, and when you advise us "to let this question rest for the present, as it cannot be scientifically solved," you

* Since the above was written, Prof. Rud. Wagner has departed this life.—Ed.

should not have been the first to raise it; for as far as I know, no Darwinist, if we must call them so, has either raised that question or drawn the above inference, for the simple reason that it neither accords with the facts nor their consequences.*

It is easy to prove our assertion as regards man and ape.

The ape-type does not culminate in one, but in three anthropoid apes, which belong to at least different genera. Two of these genera, the orang and the gorilla, must at all events be divided into different species; there are perhaps some varieties of them which form dispersive circles, like some around certain races of man. Be this as it may, this much is certain, that each of these anthropoid apes has its peculiar characters by which it approaches man; the chimpanzee, by the cranial and dental structure; the orang, by its cerebral structure; the gorilla, by the structure of the extremities. None of these stands next to man in all points,—the three forms approach man from different sides without reaching him.

I say "from different sides." For, in point of fact, these three anthropoid apes do not rise above the same fundamental form from which they branch off; but they sprang from different ape families which we must consider as having run parallel. Gratiolet has, as regards cerebral structure, followed up this subject. I shall not enter into details which must be studied in his treatise, but I shall give here the conclusions he arrived at.

"On comparing the brain of the orang with that of other brains," says Gratiolet, "we are bound, on account of the size of the anterior lobe, the relative smallness of the posterior lobe, and the development of the superficial transition convolution *(plis de passage)*, to place the orang at the head of the gibbons and the Semnopitheci, of which any one may easily convince himself on comparing the respective brains drawn with scrupulous exactness.

"These analogies are the more remarkable, as they lead to the same result as the examination of external characters."

The orang, considered as the highest gibbon, has a "gibbon's brain, only richer, more developed, in a word, brought nearer perfection."

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* This is quite true, although the author is mistaken respecting there being no Darwinist advocates for unity: I have alluded to this in the Preface.—Ed.

Of the chimpanzee, Gratiolet remarks, "On comparing his brain with that of the true Macacus, and specially of the magot, it is impossible for us to reject the analogies presented by this comparison. The examination of the skull and face confirms these analogies by new ones.

"When, therefore, we put aside every preconceived theory, and keep solely to the facts, we are irresistibly led to the conclusion: The chimpanzee brain is a perfected Macacus brain.

"In other words: the chimpanzee stands in the same relation to the Macacus and the baboon, as the orang to the gibbon and the Semnopithecus." Of the gorilla, finally, he says: "The gorilla is a mandrill, just as the chimpanzee is a Macacus and the orang a gibbon. The absence of a tail, the existence of a broad sternum, the peculiar locomotion, not upon the palmar surface of the fingers, but upon the dorsal surface of the second phalanx, are indeed characters they possess in common; but however important these may be, they do not permit the approximation of these three genera. As heads of three different series, these apes still preserve the characters of the groups to which they belong, although they possess, if I may so express myself, common insignia of their high dignity."

No valid objection can be raised to these deductions of Gratiolet, in presence of the facts; but these facts prove our assertions, that the higher developed forms of different parallel series of apes approach man from different sides. Let us imagine the three anthropoid apes continued to the human type,—which they do not reach and, perhaps, never will reach; we shall then see developed from the three parallel series of apes, three different primary races of mankind, two dolichocephalic races descended from the gorilla and chimpanzee, and one brachycephalic descended from the orang;—that descended from the gorilla is, perhaps, distinguished by the development of the teeth and the chest; that descended from the orang by the length of the arms and light-red hair; and that issued from the chimpanzee, by black colour, slender bones, and less massive jaws.

When, therefore, we look upon the apes and their development as proceeding from different parallel series, the assumption

of only one intermediate form between man and ape is unjustifiable, inasmuch as we know in our present creation three different sources for such intermediate forms.

Schröder van der Kolk and Vrolik agree with us in this respect, although they are opposed to Darwin's theory. "We know," they say, "no species of apes which forms a direct transition to man. If man is to be derived from the ape, we must search for his head amongst the small monkeys which group themselves around the Cebus and the Ouistitis; for his hand we must go to the chimpanzee; for his skeleton, to the Siamang; for his brain, to the orang, [and I add, for his foot, to the gorilla]. Putting aside the difference in the teeth, it is manifest that the general aspect of the skull of a Cebus, of a Ouistiti, or some other cognate monkeys, resembles, though in miniature, more the skull of man than the skull of an adult gorilla, chimpanzee, or orang. The *carpus* of the chimpanzee, [and of the gorilla], has the same number of bones as that of man, whilst that of the orang is distinguished by those singular intermediary bones found in all other monkeys. The skeleton of the Siamang resembles by its sternum, the shape of the thorax, the ribs, and the pelvis, much more that of man, than that of the gorilla, chimpanzee, and the orang; and our researches have also shown that the brain of the orang stands nearer to that of man than the brain of the chimpanzee. It would thus be requisite to collect the human characters from five different apes, from one of America, from two of Africa, from one of Borneo, and from one of Sumatra; the primitive relations of man are accordingly so scattered, that we can hardly believe in one common stock."

It is just this plurality of characters which confirms us in our view. If the Macaci in the Senegal, the baboons on the Gambia, and the gibbons in Borneo could become developed into anthropoid apes, we cannot see why the American apes should not be capable of a similar development! If in different regions of the globe anthropoid apes may issue from different stocks, we cannot see why these different stocks should be denied the further development into the human type, and that only one stock should possess this privilege; in

short, we cannot see why American races of man may not be derived from American apes, Negroes from African apes, or Negritos, perhaps, from Asiatic apes!

On examining the species of mankind and their history, we arrive at similar results. We have traced the plurality of species, not merely in the historic, but also in the pre-historic period; we have shown that no existing species present a greater contrast than did, *e.g.*, the cave-men of Belgium and the Rhenish provinces, and the Lapps of the stone-period. This plurality and diversity which we find in the primitive races of Europe—that is to say, upon a very limited space, will also be found in the primitive races of other parts of the world. At all events, all the facts which carry us back to the oldest history of Asia, Africa, and America admit of no other inference.

But if this plurality of races be a fact, as well established as their constancy of characters, despite of the many inter-mixtures through which the natural primitive races had to pass; if this constancy be another proof for the great antiquity of the various types, for their occurrence in the diluvium, or even in older strata—then all these facts do not lead us to one common fundamental stock, to one intermediate form between man and ape, but to many parallel series, which, more or less locally confined, might have been developed from the various parallel series of the apes.

It is not unworthy of notice that the fossil apes of the tertiary period, from which man perhaps might have issued, are much more widely spread than the present monkeys, and that they follow in their distribution the same laws as at present. The monkeys found in Europe, as high up as England, are all narrow-nosed, whilst those found in American caves are all flat-nosed. The difference between the Fauna of the Old, and that of the New World, as now observed, existed already then—there was no road which led from South America to Europe. But if apes became developed into men, they had in the old world a range from the equator up to England, and could thus form the autochthonic races upon the various spots, where we have found the oldest species of mankind. This assumption equally

leads us to an original plurality of mankind, not to their derivation from a single stock, but from the various twigs of that tree, so rich in branches, which we surround with the order of primates or apes.

Here again, gentlemen, you will observe the agreement in demeanour of the now distinct types. The simian type parts in various directions; it first divides into two chief branches—monkeys of the old, monkeys of the new world—each of these main branches produces twigs which seem more and more to part from each other. But on arriving at perfection the ends of the twigs turn again towards each other, so that from the fundamentally distinct families of the gibbons, Macaci, and baboons are developed the three anthropoid apes, which, by a number of common characters stand considerably nearer each other than the groups of which they are the heads. Does not the history of man present something similar? The further back we go in history the greater is the contrast between individual types, the more opposed are the characters—the most decided longheads immediately by the side of the most decided shortheads. Our savage ancestors stand opposed to each other—stock against stock, race against race, species against species. By the constant working of his brain man gradually emerges from his primitive barbarism; he begins to recognise his relation to other stocks, races, and species, with whom he finally intermixes and interbreeds. The innumerable mongrel races gradually fill up the spaces between originally so distinct types, and, notwithstanding the constancy of characters, in spite of the tenacity with which the primitive races resist alteration, they are by fusion slowly led towards unity.

My task is finished, believing that I have, as far as was in my power, attained the object I had in view. But before concluding, I feel bound to address a few words to friends and opponents.

The lamentation over the destruction of all faith, morality, and virtue; the woeful cry about the endangered existence of society, which years ago forced me to take up my pen, is heard again—but this time it is in the French tongue. The pulpits of the orthodox churches, the pews of the pietistic oratories,

the platforms of the missions, the chairs of the consistories, resound with the pretended attacks on the foundations of human existence made by materialism and Darwinism. They feel surprised, that people with such views can be good citizens, honest men, good husbands and fathers. There are priests, who, while defrauding the state of taxes, mount the pulpit and preach: that when materialists and Darwinists do not commit all sorts of crimes, it is not from righteousness but from hypocrisy.

Let them rage! *They* require the fear of punishment, the hope of reward in a dreamt-of beyond, to keep in the right path—for us suffices the consciousness of being men amongst men, and the acknowledgment of their equal rights. We have no other hope than that of receiving the acknowledgments of our fellow-men; no other fear than that of seeing our human dignity violated—a dignity we value the more, since it has been conquered with the greatest labour by us and our ancestors, down to the ape.

To our friends we return thanks for their support, and conclude with an anecdote.

In a satirical journal, edited by my late friend, Fritz Jenni, called *Der Guckkasten* (The Show-box), there is a picture of a cowkeeper with his milk-cans, and before him a cur, barking furiously. Says the milkman, "Thou barkest! Thou always barkest! Thou barkest at all the dogs! Thou barkest at me, and barkest till thou hast done barking, and canst bark no more!"

Then let them bark, till they can bark no more.

THE END.

APPENDIX.

The following are the passages omitted from the text, to which allusion is made in the Editor's preface, p. xii :—

P. 122, line 16 from top :—

"When Sir Walter Scott, in some of his novels, describes some Highland robber, distinguished by a disproportionate length of his arms reaching down to the knee, which enabled him better to handle his sword, he praises the ape type in man, just as the pious painter of the Byzantine school and our present Nazarenes act in depicting their Saviours and Madonnas, with their courts of saints, with long narrow ape-hands and feet, and orang-útan pelves, which warrant the immaculate conception, since no human head could pass through."

P. 147, line 6 from top :—

"Herr Bischoff proceeds further: the Esquimaux, Botocudos, New Zealanders, etc., whose appearance is certainly in many respects not superior to that of animals, have been appealed to; or instances have been cited of so-called wild men, who, lost in the forest in early youth, have grown up amongst the brutes, and became so degenerate, that on being found they exhibited scarcely any trace of a higher self-consciousness. Perhaps Herr Bischoff only calls those men who attend his lectures at Munich, or have implicit faith in the transformation of urea."

P. 165, line 4 from bottom :—

"Properly speaking, my human character is here gone to the devil! No operculum,—no covered transition convolution! To the devil with that devil's ape!* But we see how nature indicates here that the devil stands nearest to man! It is remarkable enough that the Capuchin stands by the side of the devil. In the Capuchin ape, the superior transition convolution is absent; the second is superficial in its whole extent,—the operculum almost null.

"Tables are frequently useful. I present, therefore, a synopsis of that excellent character of man,—the operculum and the convolutions :—

Part of Brain.	Man.	Devil's Ape.	Capuchin Ape.	Orang.	Chimpanzee.
Posterior lobe	Small.	Moderate.	Very short.	Moderate.	Large.
Operculum	Absent.	Absent.	Almost absent	Imperfect.	Perfect.
Superior transition convolutions ...	Superficial	Superficial	Absent.	Superficial	Absent.
Second transition convolution	Superficial	Superficial	Superficial.	Covered.	Covered.

"Receipt resulting from this Table :—Melt the Devil, and the Capuchin in ape-shape, together, and you have the Man! Nature seems to be very sarcastic!"

* The monkey in question is best known as the Marimonda (*Ateles Belzebuth*). Englishmen apply the name "devil-monkey" to the Cuxio (*Pithecia Satanas*).—Editor.

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